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## LECTURES.

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COLONEL THE HONOURABLE JAMES LINDSAY in the Chair.

### ON THE MILITARY ROADS OF THE ANCIENT ROMANS, COMPARED WITH MODERN BRITISH RAILWAYS.

BY THE REV. R. BURGESS, B.D.

I PURPOSE in this lecture to enumerate and describe those great works of the ancient Romans, with a view of comparing their magnitude with the cast iron lines that now traverse a single province of the old Roman dominions. Unpromising as this subject may seem, it has already occupied the attention of archæologists. Nicolas Bergier, the French antiquary, who died in 1623, has left two quarto volumes which he entitled Histoire des Grands Chemins de l'Empire Romain. Pratilli, a writer of the last century, has left a book on the Via Appia; and Volpi, in his work on Latium, treats of the roads which traversed that region. These learned writers, however, tell us nothing of the Macadams of those classic days, and never rise to the idea of a good turnpike road, with our usual quantity of toll

bars. The Latin grammarians distinguish three different denominations of roads: Via, Actus, Iter. The *Via* answers to the French Route Royale, and was the great main road from one capital or province to another; such were called Viæ Consulares. *Actus* we should call a bridle-road, about half the size and dignity of the Via, adapted for donkeys and bipeds; and *Iter* seems to be a general term for any path wide enough to travel upon. The office of taking care of the public roads devolved upon the *Curatores*, who appear to have had about the same power to inflict penalties for damages or trespasses as our railway companies have to keep the third class in order. Some grand lines of road were planned and completed during the Republic, but the earliest and most successful roadmakers of the empire were Julius Cæsar and M. Agrippa; of the latter Dion Cassius says, that when he was Ædile in the year of the city 721, he restored all the roads without taking a penny from the public treasury. The Emperor Augustus, of whom it has been truly said, that, with all his power and might, he had neither a glass to his window nor a shirt to his back, was magnificent enough to make up the Flaminian way as far as Ariminum at his own expense, and ordered the senators to do the same to all the other roads at their expense; he made also the *Milliarium aureum*, of which I shall shortly say something, and on the occasion of this general repairing of all the roads that issued from Rome, medals were struck in commemoration of the same, with the superscription *Quod Viæ Munitæ sunt.* Nero repaired all the roads in Spain, and I believe modern travellers in that country would like much to see him there again. Vespasian was a great restorer of the public Viæ, and Trajan's restoration of the Via Appia is immortalized in sculpture. Marcus Antoninus undertook the roads in Germany and in Belgium; and the emperors in succession, however neglectful they might be in other matters, seldom got through their career without a little engineering in this line. Finally, Theodoric is the last of the men of power we read of who repaired roads in Italy. The devastating war of the Goths and Greeks put an end to all such useful enterprises, and the roads became for many centuries almost impracticable. The materials, torn up or pushed from their site, were used for erecting towers of defence, or walls to prevent

incursions of barbarians, and not until civilisation began to dawn did the highways receive any attention from the reigning powers of Italy.

I shall now say a few words upon the materials and construction of the Viæ Antiquæ. Vitruvius does not disdain to give directions for making roads; he recommends that the engineer should choose solid ground and level it, and upon this lay his first covering; and that if there be any looseness in the soil, he must consolidate it by means of wooden piles—"Fistucationibus cum magnâ curâ solidetur." We should hardly imagine that this is a subject for poetry, but yet it is from a passage in the Poet Statius that we chiefly learn how a road was commenced. First they cut two parallel furrows, to indicate the width of the road, and then they cut down between those until they came to the hard bottom, and then began the levelling. As the construction proceeded, the road assumed a slight convex shape; the middle or top was called the dorsum, or back-bone of the way, or, as it is called in Virgil, "in aggere viæ;" roads that were left in the rough material were said to be munitæ, but when covered with cut polygonal blocks, it was a "via strata," from whence is derived the Italian strada. Specimens of this "opus stratum" are still existing on the Via Ostiensis and the Via Appia, in the neighbourhood of Rome, but a piece in the best preservation is on the Via Albana, the triumphal way that led up to the temple of Jupiter Latialis, on the Alban Mount; the letters V. N., Via Numinis, may still be read upon this pavement, which has kept its place for near 2,000 years. All these remains, and many others that might be enumerated about the hills of Frascati, Prænestе, and Tivoli, are of the same description, being composed of large polygonal blocks of basaltic lava, found in many places near Rome, particularly in the quarries near the Lake Regillus, under the Capuchin convent near Bovillæ, also near the sepulchre of Cecilia Metella. This sort of stone was called by the ancient Romans *silex*, or *lapis siliceus*, and the places where it was got were called lapidicinæ siliceæ; it will be sufficient to offer for your inspection some specimens of this material, which I gathered with my own hands in Italy. The Roman Viæ were edged by a step on each side; these were called crepidines, margines, or umbones; they were about nine inches in

elevation. The other materials used in roads were a mixture of broken fragments of all sorts, called "rudus," which we should call in plain English, rubbish; terra cotta, called testa; and that most plentiful of materials used in all the works of Rome, tufo. I also offer some specimens of that article taken from the quarries described by Vitruvius, near Rome. The Roman roads issuing from the gates of Rome, or branching out in the immediate neighbourhood, were twenty-nine in number; they were measured by a thousand paces, Mille Passuum, which is the origin of the word mile, and short round pillars, called milliaria, marked the distances from each gate. In the Forum there was set up a pillar, on which were inscribed the distances from Rome to each city, where the roads respectively had their terminus. The distances were not measured, as has been erroneously supposed, from this pillar or golden milliarium, but they were measured from the gates. This fact of the distances being measured from the gates, is ascertained by the first milliarium on the Via Appia having been found in its place in the Vigna Nari, on the right of the St. Sebastian gate, and the distance of a 1,000 paces being measured by Fabretti towards Rome, was found to coincide with the ancient site of the Porta Capena. The principal roads issuing from the gates of Rome are exhibited on the sketch before you, but you will not expect me to travel with you on them all. I must select two for notice and one for detail, when I have first stated the authorities we have for the names, number, and direction of all the roads in the Western empire. There are three ancient itineraries which have come down to us, enumerating, like a modern Livre de Poste, the various roads and distances from place to place. The first is commonly called the Itinerary of Antoninus, because it was made and published during the peaceful reign of the Antonines, the golden period of the Roman empire. During those forty years of peace and good government, the arts and useful public works were encouraged; and it is one of the blessings upon which we may congratulate the profession of architectural science and art, that it flourishes best in the atmosphere of peace and good will on earth. The second Itinerary was discovered at Augusta (Aost), in the possession of a certain Conrad Peutinger, and is known under the name of the Carta Peutingeriana; it is evidently of Christian times, men-

tion being made of St. Peter's Church; the orthography betrays the corrupted language of the eighth century, but, notwithstanding these defects of composition and spelling, it is a precious document, and unique of its kind, being the only one that affords us the least information of the state of the world at that period. The third of these ancient Itineraries was found at Bordeaux; it describes the journey from that city to Jerusalem, and is known on that account under the title of the Jerusalem Itinerary; it appears to be of about the same date as the Carta Peutingeriana. These are the three documents from which is to be gathered all that can be known of the public roads of the Roman empire. The two ancient Viæ best known to the present world are the Via Flaminia, by which travellers from the North enter Rome, and the Via Appia, by which they leave it to travel to Naples. The Via Aurelia, which led to Centum Cellæ, now Civita Vecchia, has recently acquired a celebrity which it never enjoyed in ancient times.

The Via Flaminia, however, does not proceed in the direction of the modern road to Florence beyond the Ponte Molle; after passing that bridge, which is two miles from the gate, the post road falls in with the Via Cassia, and the Via Flaminia leads into solitudes and Mount Soracte. This celebrated Roman road was constructed by Caius Flaminius, the unfortunate consul who fell at the battle of Thrasimene; at that time the Flaminian gate was at the upper end of the Corso, under the Capitoline Hill, so that it was always reckoned ad Pontem III. The Via runs through the Campus Martius; it ended at Arimenum, now Rimini, a distance of 222 miles; it passed through Narni, Terni, Spoleto, before it cut through the Appenines to reach Pisaro, and in some places, especially between the Ponte Molle and Soracte, considerable remains of it may be traced. The road which I shall rather seek now to describe, and make the object of comparison, is the Via Appia, upon which were bestowed the greatest care and expense, both under Republican and Imperial Rome. It was chiefly on the Appian way that the great triumphal processions approached Rome from the East; the chariot wheels of Pompey and triumphant Sylla moved over its pavement, which, in some places, still exists; its splendid sepulchral monuments on each side of it have left their skeletons to mark its

direction ; and we may still stand near the tomb of Cecilia Metella, and imagine, amidst the stillness which now prevails, the shouts of the applauding multitudes which welcomed Cicero from exile. This was called the Queen of Roads, as Statius the poet sings :

Appia Longarum teritur regina Viarum.

This road was first constructed by Appius Claudius, the censor, 310 years before the Christian era ; it was repaired and laid down in many places with new silex by Trajan, and, in all probability, made entirely anew from Beneventum to Brundusium ; several of the milliaria are still standing along the Pontine Marshes, bearing inscriptions which tell us that Trajan laid it down with silex, at his own expense, *silice suâ pecuniâ stravit*, and the dates square with the 104th year of the Christian era. We have a graphic description of the Via Appia given by the secretary of Belisarius in the sixth century, which it will be interesting to hear. "To traverse the Appian Way," says Procopius, "is a distance of five days' journey for a good walker, and it leads from Rome to Capua ; its breadth is such that two chariots may meet upon it, and pass each other without interruption, and its magnificence surpasses that of all other roads. For constructing this great work, Appius caused the materials to be fetched from a great distance, so as to have all the stones hard, and of the nature of millstones, such as are not to be found in this part of the country ; having ordered this material to be smoothed and polished, the stones were cut in corresponding angles, so as to fit together in jointures, without the intervention of copper, or any other material to bind them, and in this manner they were so firmly united, that in looking at them one would say they had not been put together by art, but had grown so upon the spot, and notwithstanding the wearing of so many ages, being traversed daily by a multitude of vehicles and all sorts of cattle, they still remain unmoved, nor can the least trace of ruin or waste be observed upon these stones, neither do they appear to have lost any of their beautiful polish ; and such is the Appian Way." Whatever we may say about our modern railways and great works of the present century, the paving of Appius Claudius, made just 2161 years ago, might be safely recommended to the study of the Curators of Oxford

Street and the Marylebone Vestry the next time they lay their heads together to make a wooden pavement. I shall give but one specimen of the form of those ancient Itineraries to which I have alluded, by taking the journey from Rome to Capua, properly called the Via Appia; the further distance, from Capua to Brundusium, must be considered as an addition made subsequently. The Itinerary of Antoninus gives the stages and distances thus:

| | |
|---|---|
| Ariciam . . . . | M. P. XVI. |
| Tres Tabernas . . . | M. P. XVII. |
| Appii Forum . . . | M. P. XVIII. |
| Tarracinam . . . | M. P. XVIII. |
| Fundos . . . . | M. P. XVI. |
| Formiam . . . | M. P. XIII. |
| Minturnas . . . | M. P. IX. |
| Sinuessam . . . | M. P. IX. |
| Capuam . . . . | M. P. XXVI. |

The Via Appia coincides with the modern road that now leads from the church of S. Cesario, where the Via Latina branches out from it, to the church of S. Sebastiano; continual traces of the old pavement may still be seen, as the way runs betweens the naked masses of sepulchres to the ruins, commonly called Roma Vecchia; a little beyond those ruins, which appear to be the remains of a little castrum, the old via falls in with the modern road to Albano, which leaves Roma by the Porta S. Giovanni Laterano; at ten miles from the site of the ancient Capena gate, which stood under the Thermæ of Caracalla, is to be recognised the site of the ancient Bovillæ; and in going from thence, the Via Appia passes through the slope of the Alban hills, and reaches the Valley of Ariccia; here we find the first great work which belongs to this queen of Roman ways. The modern road passes through the town of Ariccia, but the old via passed beneath it, having to traverse a valley, and to sustain its level. It is here that we find those magnificent substructions to which I have already alluded; the whole extends for a length of 100 geometrical paces, and the greatest depth or elevation is 33 ft., the least 3 ft.; the whole is a solid mass, except three arches, used for economising of materials, and for greater solidity; and I do not perceive that, in the whole sixteen miles which we have now travelled from Rome on this via, there are any great cuttings or levellings

which would pass the ordinary labour of laying down a road; from Ariccia we descend to Genzano, and approach the Lake of Nerni.

The Via Appia, having now reached the edge of the Pontine Marshes, runs in a dead flat to Terracina; the next two stages (mutationes) after Ariccia, bring us to names consecrated in sacred history; the Christians of Rome thought it not a journey too far to go out, some thirty-three miles, and some fifty-one, to meet the great Apostle of the Gentiles coming from Puteoli, at Appii Forum and the Three Taverns. But at Terracina it was necessary to cut away the rock, to make room for a passage between Anxur and the sea-shore; the white rocks of Anxur still shine in the sun, as they did when Horace made his journey to Brundusium, and I consider this passage of the rocks of Anxur to have been the second great work in making the Via Appia. Sixteen miles further is the town of Fondi, and it is easy to see that much labour has been expended about that ancient town, and about Itri, in carrying on the straight line of road, but after clearing Formia, near the present Mola di Gaeta, the difficulties must have ceased; the famous Minturnian Marshes might require a large quantity of the *rubus* and *fistucationes* of Vitruvius, to gain a solid bottom, but nothing serious obstructs the engineer until he arrives at Capua, having effected a distance of 142 miles. There is one particular in which the engineering of Roman roads and modern railways coincided, they both pursued a straight line, both filled up hollows, or bestrode vallies and glens by viaducts and bridges, both cut through hills, and cleared away opposing rocks, and even a tunnel is not wanting to compare with some of our own, in the Grotto of Posilipo, near Naples, and the cuttings of the rocks of Anxur may be placed at humble distance with the blasting of the cliff at Dover. But in making these comparisons, it is always to be borne in mind that the ancients had no gunpowder, and wanted all those mechanical inventions which modern science has given us; but even in a comparison of manual labour and quantity of material, it might, I think, be shown that all the great works of the Roman Empire would hardly equal in the aggregate the works which now exist in a single, and that the most contemptible province of the dominions of Augustus Cæsar. Before I proceed to speak of our own great works, I will

enumerate some of those of the greatest celebrity belonging to the ancient Romans. The substructure of the Ariccian Valley may be calculated by cubic feet of masonry, if we may so call these large masses of stone laid one upon another; taking those substructions at 500 ft. in length, 18 ft. in mean depth or height, and a width of 26 ft. as measured by Pratilli, and supposing the mass to be solid and uniform, we get an amount of 234,000 cubic feet. I have already mentioned the cutting of the rock of Terracina; another example of great manual labour is to be seen in going from Rocca di Papa to the Via Latina, under the Mons Algidus; the mount is cut for a considerable distance down to a depth of 50 ft., so as to give a narrow passage, in which the traveller finds himself a prisoner, if any one chose to block up the entrance either way. Again, three miles from Acqualagna on the Via Flaminia, not far from Fossombrone, there is a great work, a narrow passage cut out of a rock, a part of which is even cut through, so that an arch is formed over head; it appears from traces of inscriptions, that Vespasian was the author of this bold enterprise.

We are all familiar with the Pont de Gard, near Nismes, which I cite because it was a bridge as well as an aqueduct. Perhaps, the greatest work of all is the Via Trajana, leading to his bridge across the Danube; there, under a perpendicular cliff, a road is ingeniously cut out, and a foundation given to it by means of beams inserted in the rock; and every one must admire the skill which has overcome such formidable obstacles to making a road. Drawings illustrative of this great work, and a detailed description, may be seen in Paget's work; the bridge to which the Via Trajana led was the same as that which is sculptured on his triumphal column.

I shall hardly cite as works of human labour the wonder of the Phlegrean fields, in the Bay of Baiæ; for there the earth has been cut and slashed by the power of volcanic action, and the ground tunnelled in various directions without the intervention of the iron instrument. The poets in these regions made an easy descent to Avernus. Even the grotto of Posilipo is half-formed by nature, and it must be confessed, wonderful as the passages are which are perforated in this alluring region, that the Box Tunnel would

swallow them all, and a single company of railway directors digest them at a sitting. But we have not seen all the magnificence or the industry of the Romans. In the Itineraries, published by Wesseling, Gale and Stukeley for Britain, and M. Danville for Gaul and Italy, we may acquire some idea of this branch of Roman economy. From the wall of Antoninus to Rome, and from thence to Jerusalem, that is, from the north-west to the south-east point of the empire, was measured a distance of 3,740 English miles; of this distance 85 miles only were sea-passages, the rest was the road of polished silex, such as I have described. Posts were established along these mighty lines of high road, so that a hundred miles a day might be with ease accomplished. In the time of Theodosius (as the historian Gibbon quotes from Libanius) a magistrate went post from Antioch to Constantinople; he began his journey at night, was in Cappadocia, 165 miles from Antioch, the ensuing evening, and arrived at Constantinople the sixth day about noon—the distance being 685 miles. This, however, is not equal to the speed with which the Tartar couriers go from Constantinople to Belgrade, often accomplishing that distance of 800 miles in five or six days. It is right to mention a fact related by Pliny, as affording an example of the quickest travelling in a carriage I am aware of in ancient times. Tiberius Nero, with three carriages, accomplished a journey of 200 miles in twenty-four hours, when he went to see his brother Drusus, who was sick in Germany.

We shall now turn to a single province of the Roman Empire, and we see with wonder and admiration how its resources of wealth and genius have surpassed all the glory of the then known world. The distance between the two extremities of the dominions of the Antonines, exclusive of sea-passages, was 3,655 miles. I am willing to suppose that this great line of road was laid down with polished stone, and might have cost as much per mile as the Via Appia. If we suppose our numerous turnpike roads (some of which were made at a great cost) to be a set-off against the branch roads of the Roman Empire, which were often inferior in construction, then we have about 5,000 miles of railway in Great Britain alone, to compare with the great line which joined Jerusalem with the Firth of Forth. We have no means of estimating the cost of a

mile of Roman road by any audited account of expenses, and it is not easy to make a comparison of labour. The following may help us to form some idea, rather than any estimate. In the high-level Bridge of Newcastle, the quantity of masonry, in piers and in land-arches, approaches, &c., is 681,609 cubic feet, and the cost of that masonry was £120,000. I find this to be about 3*s.* 6½*d.*, let us say 3*s.* 6*d.*, per cubic foot, and if estimated by the cost of labour, and the greater difficulty in the transport of material, I doubt whether the old Romans could do it for less. In those magnificent substructions of the Via Appia near Ariccia, we have found by measurement (taking the whole mass) about 234,000 cubic feet. Now the internal mass in all cases was, to use a Vitruvian term, *ad emplecton*, or, as we might call it, rubble; making all due allowance for this, I should not have in the Valley of Ariccia, reckoning the stone-work 5 feet on each flank, more than 100,000 cubic feet, *i. e.* reckoning at 3*s.* 6*d.* per cubic foot, about £17,000 worth of real masonry; and this in the tenth part of a mile In the whole length of the 142 miles to Capua, we do not find more than two other extra works, viz. at Terracina and at Fondi; so that the cost of the Via Appia would not probably exceed £32,000 (the average price of a mile of our railway) above the ordinary expenditure of making a common road. I confess this is a vague calculation, if even it can be called one; but if it should be raised to the utmost stretch of imagination, it would be insignificant, as to pounds sterling, by the side of our leviathan railroads. The following I have on good authority, as the average cost of a mile of railway throughout Great Britain; the cost being, of course, very unequal in different places:—

| | £. | |
|---|---|---|
| Land . . . . . | 6,000 | |
| Earthwork . . . . . | 5,000 | |
| Tunnelling . . . . . | 3,000 | |
| Masonry . . . . . | 3,000, | ordinary line |
| Viaduct and Large Bridges . . . | 3,000 | |
| Permanent Iron Road . . . | 5,000 | |
| Stations . . . . . | 4,000 | |
| Law Expenses, Engineering, Survveying, &c. | 3,000 | |
| | ——— | £32,000. |

If this be multiplied by 5,000, which was the aggregate length of

British railways in 1851, and is now, of course, considerably larger, we have the almost fabulous amount of 160 millions, a sum fully equal to ten times the revenue of all the Roman provinces in the time of Augustus. I have spoken of 234,000 cubic feet of masonry and rubble as contained in one of the great works of the Via Appia; the high-level Bridge at Newcastle alone, as we have seen, contains of masonry 681,609, of rubble 116,396, of concrete 46,224, total 844,229, besides 5,050 tons of iron, of which the Romans knew nothing; the whole cost of this undertaking was £234,450. The cubic feet of masonry in the Britannia Bridge, which we must consider as a viaduct, and the wonder of the present age, is 1,500,000, and the cost, approximately calculated by Mr. Edwin Clarke, was £601,865; the cost of the Conway Bridge, with £38,500 worth of masonry, was £145,190; and finally the Tweed Viaduct is said to contain two million cubic feet of masonry. We have then in these four great works alone—the Britannia and Conway bridges, the Newcastle and Berwick viaducts or bridges, near 4½ millions of cubic feet of masonry; the whole costing not less than £1,280,000. That is to say, if we could find in the Roman Empire one hundred such works as the celebrated substruction of the Via Appia, they would hardly equal in masonry or stone-work these four productions of the "ultimi Britanni;" this is independent of such material as the ancient Romans could not procure, and for which we must not charge them;—9,420 tons of iron were employed in the Britannia Bridge, and 5,050, as I have said, in the high-level Bridge of Newcastle. It is probable that whole armies worked at the Roman roads, bridges, and viaducts, and it would not be fair to compare their mechanical apparatus with the scientific inventions of modern times; but it may be doubted whether they ever presented such a union of physical power as was seen one day on the Menai Straits, when 650 men were employed in raising the second tube of the great bridge, of whom 386 were sailors; and although, as I have said, we have but little or no data to go upon for making a comparison of expenditure and labour, yet we may gather enough to maintain the proposition, that all the great works of the Roman empire connected with their lines of communication did not equal the works of a similar kind which now exist in the

island of Britannia. Another thing which hinders us from making comparisons as to cost, *we* have in every line of railway £6,000 per mile for land—Appius Claudius cut through the country of the Volsci without asking the price, and dispensed with all juries for assessing damages. The " mutationes " (hovels where they changed horses) were all the stations that occurred on their line—the comforts of law expenses were not known, and I doubt much if the surveyors and engineers got £1,200 a-mile. I wish I could have found how many sestertia Trajan paid for his restoration of the Via Appia, but all the data I have to guide me in the calculation of that expenditure are, that Trajan paved the road out of his own money, *de suâ pecuniâ stravit;* this, however, is more than can be said for many of the projectors of our modern railways—*de alienâ pecuniâ ferro straverunt, i.e.* they laid down the iron with other people's money, might be a more appropriate inscription. When Augustus re-made the Flaminian way to Rimini, he was the sole shareholder, and gave no scrip. Julius Cæsar and Marc Antony raised great works, but they knew nothing about raising dividends; but that which would have astounded them more than an irruption of barbarians, would have been a bill of £1,800 for every mile of road for parliamentary and law expenses; if this be a true average, which I have authority for stating that it is, then we may deduct from the cost of 3,740 miles of Roman road, which led from Scotland to Jerusalem, the sum of £6,732,000; and if those worthies of old time had been called upon to make 5,000 miles of road in the province of Britain, they might have economized 30 millions of our money by paying nothing for land. In estimating the value of a Roman road, therefore, we have to deduct £7,800 a-mile for land and law, and £4,000 for stations, and £5,000 for iron, before we come to the materials they were enabled to use; in other words, the materials of the Roman road and labour would not be more than half the cost of our railways, from the mere fact of certain expenses being absent, which they could not understand; but, although inferior to the Britons of the nineteenth century in the art of spending money, if judged by the present state of the science, they could not be despicable engineers—their levels were chosen on different principles, but their lines of roads passed through the same countries, and gene-

rally in the same direction, as our railways. A diagram taken from an article of the Quarterly Review, written some years ago, exhibiting a general view of the direction of the principal Roman roads in England, shows that on comparing one or two of our principal lines, we shall find that the Great Western, *e.g.* supplies the place, with a little deviation near Reading, of the Roman iter from London to Bath and Bristol; the Liverpool and Manchester, and on to Leeds and York, replace the northern Watling Street; the Eastern Counties follow a Roman way, and so of the rest.

In boasting of the gigantic steps which the art of road-making has taken in our time, we cannot afford to depreciate either the genius or the magnificence of the ancient Romans in this matter. If we have our railway under the cliffs of Dover, Trajan had his road under 2,000 feet of perpendicular cliff along the Ister; if we have our 5,000 miles of rails, the Romans had their 4,000 miles of chosen road, reaching from one extremity of the empire to the other; if we have our leviathan bridges and viaducts, the Romans had theirs over greater rivers and wider vales than we have to deal with; and, finally, if we had our glass bazaar, one-third of a mile long, in Hyde Park, they had a golden palace, which reached a whole mile on the Esqueline Hill. If we rise superior and look down upon the works of the Romans, it is not so much that we have gained in unskilful labour, as in science. Without the iron and the science, their works would be as great as ours; it is in mental rather than in any physical energies, that we have the pre-eminence; it is what our last great poet has called the "divine particle," which has been dilated by Him who gave it to man, that has enabled us to cope with the very elements, and wing our way against wind and tide over oceans and seas unknown to the ancients. The spirit of a man which is in him is capable of knowing the things of a man, and this capability it is the business of all associated bodies to foster and draw out; it is not, perhaps, yet known of what the human thought is still capable, but the blessing of every discovery in art or science which procures fresh enjoyment for man is, that it brings brute force to a discount, and teaches to mankind the lesson of fraternity and peace; and it is not perhaps too much to say that this question of roads, by which all nations of the earth are brought

within the possibility of meeting again on some plain of Shinar, is calculated more than any other human instrument to renew the face of the earth.

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June 19th, 1857.

COLONEL THE HONOURABLE JAMES LINDSAY in the Chair.

## THE MEANS OF PRACTICALLY APPLYING THE PRINCIPLES OF MEDICAL GEOGRAPHY, FOR THE PRESERVATION OF THE HEALTH OF SOLDIERS AND SEAMEN IN FOREIGN CLIMATES.

BY DR. BIRD, F.G.S.

LAST year I laid before you the principles of Medical or Noso-Geography; in other words, the facts of physical geography and vital statistics, inductively used for investigating the laws under which health and disease are distributed through the human family, and in various latitudes. On that occasion I brought to notice, how that this promising field of research forms only part of medical etiology, or a knowledge of the causes of disease, associated with geographical situation, and the climatology of particular countries; and that if those entrusted with the health of, or in command of, either soldiers or sailors in those countries, would but rightly appreciate the importance of the duties committed to them, they would endeavour to acquire useful knowledge of the influence of climate on health, and of subjects connected with the treatment as well as the prevention of disease.

The more material agencies which geographically regulate not only the diversities of vegetable and animal structure, but the production of disease also, are the geographico-meteorological causes of atmospheric temperature and humidity, measured by isothermal lines, which connect places having the same mean temperature, but which differ sensibly from the lines of latitude. The mean temperatures calculated from an equatorial mean of 81° 50′ Fahr.,

according to Dr. Brewster's formula, and which differ considerably from the mean temperatures obtained by observation, are given in the annexed Table from Daniell's Elements of Meteorology:

| | Latitude. | Observed Mean Temperature. | Mean Temperature calculated by Formula. | Difference. |
|---|---|---|---|---|
| | ° ′ | ° | ° | ° |
| Equator | 0 0 | 81·50 | 81·50 | 0·00 |
| Columbo | 6 58 | 79·50 | 80·90 | 1·40+ |
| Chandernagore | 22 52 | 75·56 | 75·10 | 0·46— |
| Cairo | 30 2 | 72·82 | 70·56 | 1·76— |
| Funchal | 32 37 | 68·54 | 68·62 | 0·08+ |
| Rome | 41 54 | 60·44 | 60·66 | 0·22+ |
| Montpellier | 43 36 | 59·36 | 59· | 0·36— |
| Bourdeaux | 44 50 | 56·48 | 57·82 | 1·34+ |
| Milan | 45 28 | 57·18 | 58·28 | 1·10+ |
| Nantes | 47 13 | 54·68 | 55·35 | 0·67+ |
| St. Malo | 48 39 | 54·14 | 53·85 | 0·29— |
| Paris | 48 50 | 51·89 | 53·65 | 1·76+ |
| Brussels | 50 50 | 51·80 | 51·47 | 0·33— |
| Dunkirk | 51 20 | 50·54 | 51·25 | 0·71+ |
| London | 51 30 | 50·36 | 50·74 | 0·38+ |
| Bushey Heath | 51 37¾ | 51·20 | 50·58 | 0·62— |
| Kendal | 54 17 | 46·02 | 47·58 | 1·56+ |
| New Malton | 54 10 | 48·28 | 47·53 | 0 75— |
| Lyndon | 54 34 | 48·90 | 49·37 | 0·47+ |
| Dublin | 53 21 | 49·10 | 48·65 | 0·45— |
| Copenhagen | 55 41 | 45·68 | 45·95 | 0·27+ |
| Edinburgh | 55 57 | 46·23 | 45·64 | 0·59— |
| Carlscrona | 56 16 | 46·04 | 45·46 | 0·58— |
| Fawside | 56 58 | 44·30 | 44·26 | 0·04— |
| Kinfauns | 56 23½ | 46·20 | 45·12 | 1·08— |
| Stockholm | 59 20 | 42·26 | 41·57 | 0·69— |
| Upsal | 59 51 | 42·08 | 40·94 | 1·14— |
| Abo | 60 27 | 40·00 | 40·28 | 0·28+ |
| Umeo | 63 50 | 33·08 | 35·96 | 2·88+ |
| Uleo | 65 30 | 33·26 | 34·38 | 1·11+ |

These mean temperatures are usually higher in the same latitude of the old world than of the new, and are greater in northern than in southern latitudes. Thus the isothermal line of 59° Fahr., traverses the latitude of 46° in Europe, but descends to latitude 36° in America. The general causes which disturb the symmetrical distribution of temperature, are, the annual variations of the upper equatorial and lower polar currents of the atmosphere, the difference of contained humidity, the unequal distribution of land and water in various countries, the peculiar nature of the surface land, and its relative height above the level of the sea. All these causes have more or

less influence in determining the local temperature or climate of places, and in fixing the isothermal lines that mark out the zones of disease.

It can be asserted only in a limited sense, and relatively, that certain class diseases are mainly *dependent* on, or *independent* of, temperature and moisture. Specific diseases of a miasmatic and zymotic kind are materially under the influence of these meteorological causes, aided by the concurrent ones of topographical situation, geological nature of and elevation of the soil, state of the vegetation, and domestic habits of the people. Those diseases, again, which mainly arise and prevail *independent* of such influences, or diseases called *dyscrasial*, which are of constitutional origin, and result from depraved conditions of the blood and impaired nutrition, are not limited by isothermal lines to particular quarters of the globe.

The class of miasmatic diseases and those of a self-generated contagious type, as remittents, yellow fever, plague, genuine typhus, and cholera, require a fixed amount of temperature and moisture for their production and prevalence. Dyscrasial or constitutional diseases of depraved nutrition—as cachectic ulcers, rheumatism, scurvy, and consumption, which arise from a special cell-degeneration in particular bodies, are not absolutely, but relatively, independent of temperature and atmospheric humidity; although consumption is more prevalent in the tropical than in the arctic regions.

The zones, or belts of disease, thus geographically marked out on the globe, are the *tropical*, *temperate*, and *polar* zones.* The north limit of the first is formed by the isothermal line of 77° Fahr. This line ascends somewhat in summer, when the sun is north of the equator, and descends again in winter, when the sun is to the south of it. While it forms the northern limit of the tropical zone, where we find the worst forms of malarious, intermittent, remittent, continued, and yellow fevers; and of those diseases found in alliance with them, as dysentery, diarrhœa, cholera Indica, and affections of the liver; it is also the southern bar to the prevalence of epidemic *contagious typhus*, which is the proper and peculiar product of the next, or temperate zone; whose limit southwards is the isothermal

* No map of these zones is here given, as the reader may find one in Mr. Keith Johnston's Atlas of Physical Geography.

according to Dr. Brewster's formula, and which differ considerably from the mean temperatures obtained by observation, are given in the annexed Table from Daniell's Elements of Meteorology:

| | Latitude. | Observed Mean Temperature. | Mean Temperature calculated by Formula. | Difference. |
|---|---|---|---|---|
| | ° ′ | ° | ° | ° |
| Equator | 0 0 | 81·50 | 81·50 | 0·00 |
| Columbo | 6 58 | 79·50 | 80·90 | 1·40+ |
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| St. Malo | 48 39 | 54·14 | 53·85 | 0·29— |
| Paris | 48 50 | 51·89 | 53·65 | 1·76+ |
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| Dunkirk | 51 20 | 50·54 | 51·25 | 0·71+ |
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line of 77° Fahr. and northwards that of 41° of the same scale. The polar zone, again, which extends beyond these two zones, is directly opposed in climate to that of the tropical zone. Its southern boundary is the line of 41° Fahr., while its northern limit extends 8° or 12° below the zero of Reaumur.

The temperate zone embraces the extreme climatic conditions of the two other zones, under the seasons of summer and winter. At these periods, the prevailing disorders, to which armies and military masses moved from one country to another are peculiarly subject, will partake alternately of the character of diseases prevalent within the tropical and polar zones. The results and experience of the Crimean expedition have afforded ample evidence of this fact. In the Crimea more particularly, and in all the European countries of this zone, both soldiers and seamen, but especially the former, will suffer greatly in summer from diarrhœa and dysentery, from intermittents, fevers of a remittent and continued type. The latter, under bad diet, and imperfect ventilation of the soldiers' huts and hospitals, soon degenerate into genuine *contagious typhus*. This true typhus, once so prevalent, and now but rarely seen, under a better and more scientifically administered sanitary system, as well as the true glandular plague, have their special habitation in this zone, between the thirtieth and fortieth degrees of northern latitude; and, though occasionally propagated beyond these limits, by a secondary and specific poison generated from human bodies, they have evidently a distinct primitive origin from atmospheric agencies.

Yellow fever, also, from the tropical regions, makes occasional incursions into this zone, when favoured, during summer, by tropical identity of climate. Under high degrees of temperature it has appeared, both at Gibraltar and Cadiz, and in America southwards beyond its usual limits, under like favouring circumstances. But, as soon as the temperature falls below 55° of Fahrenheit, the importation of yellow fever into this zone becomes impossible, and supersedes the necessity of quarantine. Plague, like the yellow fever, is limited to low, filthy localities, but differs from it by being destroyed by high degrees of temperature. Both are limited in their prevalence by elevation of site above the level

of the sea; such elevation being associated with decrease of temperature, exerts the same agency against their prevalence as do certain isothermal lines and increase of latitude.*

Having thus briefly recapitulated the principles of medical geography, which formed the chief heads of a former lecture, I shall, on the present occasion, point out the means of practically applying such principles for the preservation of the health of soldiers and seamen in foreign climates. Political motives, and the circumstances of warlike operations, frequently render it necessary that both soldiers and seamen should be located in unhealthy situations; but timely precautions, and the resources of hygienic knowledge, are capable of averting their injurious effects, when unacclimated masses of men are exposed to those external and internal agencies which pervert the normal condition of individual constitutions. When we reflect that, in this matter, causes susceptible of removal are, from prevailing ignorance, allowed too often to exaggerate the evils of disease, incident to assembled multitudes; we may well wonder why, until very lately, so little should have been done to apply the resources of professional knowledge, for the prevention and amelioration of diseases in our military settlements, and more particularly those consequent on warfare.

While soldiers are exposed, alike with persons in civil life, to topographical and atmospheric influences peculiar to the different geographical zones of disease, they are somewhat differently placed in regard to other agencies, to which the unfettered emigrant is not exposed, and to which he may at least accommodate his constitution. The principal of such agencies are the unacclimated and unmodified constitutional states of soldiers and seamen, suddenly removed from one geographical zone to another; the condition of their diet, drink, and cooking; the state of their clothing, barracks, berths, huts, hospitals, camps, and bivouacs; their marches, ordinary exercises, habits, and discipline. On the subject of these, certain rules are laid down for the guidance of men in the army and

* Dr. Lawson has forwarded home a paper on the late epidemic outbreak of yellow fever at Jamaica, in which it is statistically shown that this disease is occasionally prevalent beyond the now fixed limit of elevated site.

navy, from which they are not permitted to deviate, whether such rules may have been laid down with due regard to sanitary results or not.

In regard to acclimatation, we may observe, that not only do the states of the blood but the physiological conditions of the long resident and recently imported inhabitants differ. No better proof of this need be cited than the fearfully destructive effects of yellow fevers in the West Indies, which carried off thousands of our soldiers and seamen at the commencement of the last war, while the residents of those islands were comparatively exempt; and had the barracks and hospitals then constructed in those colonies been placed in better selected and more elevated sites than was the practice in those days, a vast saving of life and expense might have been earlier secured for this country.

From the high temperature of the tropical zones, and the consequent diminution of inhaled oxygen, the blood of the European becomes more loose and venous than in the temperate zone, is distributed more in the venous than arterial trunks, and gives rise to an increased elimination of bile by the liver; whose vicarious action, concurrent with the increased functions of the skin, is set up in aid of the respiratory function, in order to carry off the superfluous carbon of the blood. The necessity for producing the same continuous supply of animal heat now ceases, and with this ceases also the appetite for large quantities of nitrogenous and oleaginous food, which had been previously vigorous. Neither digestion nor respiration is in a condition to supply any longer the production of abundant rich blood, which is no longer wanted for the necessities of the system. Should nature, under such circumstance, not be thwarted by improper indulgences of drinks and diet, she increases those eliminating functions of the skin and liver by which the systemic blood is rendered poorer in quality, smaller in quantity, and suitable to the wants of the body. Dr. John Davy ascertained that, under high degrees of temperature within the tropics, the heat of the human body at first increases with the temperature of the air, and falls as the atmosphere cools, within certain limits.

Although his researches be little more than an approximation to truth, they have clearly established that, on first landing in tropical

climates, the standard heat of Europeans is raised two or three degrees, accompanied by febrile symptoms; that the reduction of the body's temperature to a normal state requires temperance and abstinence from alcoholic drinks, moderation in eating, and the sparing indulgence in animal food; with avoidance of all causes of excitement increasing vascular action, and particularly exposure to the sun. The tropical new comer should at the same time use cooling drinks, as sherbets of various kinds, and frequently have recourse to tepid ablutions of the body. In the East Indies a large proportion of the inhabitants use an almost exclusive vegetable diet; and in the West Indies the black and brown races indulge sparingly in animal food. The former, in respect to Europeans, are of comparatively feeble constitutional power, which exempts them from those more severe and venous congestive forms of fever that prove so destructive of the latter. This very feebleness makes native soldiers, *or Sepoys*, more subjects of rheumatism and emaciation after mild forms of intermittent fever, predisposes them to destructive ulceration, and renders them more susceptible of injury from large doses of mercurial preparations, and like heroic remedies which reduce the fibrinous condition of the blood. The black and creole races of the West Indies, too, though more liable than Europeans to suffer from diseases of defective nutrition, are less susceptible of those generated by plethora and constitutional vascular excitement. Cerebral and nervous affections are here more severe and common than in the temperate zone, and require for their prevention rigid abstinence from alcoholic stimuli. But many tropical diseases, among soldiers, are caused by sudden refrigerations of the body and vicissitudes of temperature. The period for acclimating Europeans is about two years.

In the temperate and polar zones again, where vital action is more energetic, and the blood more abundant and arterial, Providence wisely provides the increased density of the atmosphere, for maintaining the uniform temperature of the body, by the increased quantity of inspired oxygen, and a greater appetite for hydro-carbonized or heat-producing articles of diet and drink, such as starch, oil, fat, and hydro-carbonized stimuli. But just as the excess of carbon and hydrogen, in fat and oleaginous food, is requi-

site in very cold climates for maintaining bodily warmth, so is a due proportion of *nitrogenous* or nutritive food also necessary. Without a sufficient supply of *nitrogenous articles* of diet, animal and vegetable, containing flesh-like or proteine compounds, the nutrition of the body fails, its vital power becomes enfeebled, and scorbutic disease is established, whether the *diatetic restriction* be to the animal or vegetable kingdom. Diversified diet is thus necessary for the sustenance of the body in healthy degrees of vigour, even in the temperate zone of Europe; yet the natives of hyperborean regions, who cannot obtain farinaceous articles of diet, subsist exclusively on animal food of the coarsest kind, without degenerating in physical condition. Their purely animal diet of an oleaginous kind requires vigorous assimilating organs for its elaboration; and, as a greater quantity of oxygen is absorbed into the blood, a greater production of animal heat compensates for its more rapid substraction by surrounding cold media. The inhabitants of the Arctic regions, when brought to this country, suffer much from the heat of our summer and autumn; and in this respect the Greenlander is similarly situated as the European, when transported for a few weeks to a tropical climate. The established functional actions of the animal economy, associated with certain concurrent conditions, generate more than the requisite degree of heat for the wants of the system; and, as the quantity abstracted is less than that produced, it rarifies and expands the circulating fluids, exalts nervous irritability, and increases vascular action.

The influence of foreign climates has been specially elucidated by the elaborate statistics of our army and navy. Investigation into the principles of medical geography, then, in relation to such influence, and the circumstances to which particular places are indebted for their salubrity or otherwise, may be viewed as the theory of *Hygiene*, or a knowledge of the external and internal causes of diseased action. The means of destroying these morbific causes, or the practical application of this knowledge for the prevention of disease among soldiers and seamen, in various climates, is the object of practical military and naval Hygiene. This is a subject of the greatest utility when directed to the adoption of measures likely to

diminish the great loss of life annually experienced in our settlements abroad. The true and practical end of Hygiene is to point out the best means of assimilating the human constitution to new employments and climates, and to recommend such measures as are sure of neutralising the effects of hurtful agencies, to which individuals or multitudes may be exposed. The means best adapted for obtaining the first end in view, or the acclimatation of the raw soldier or sailor to new climates, consist in the proper adaptation of their diet, clothing, and duties to the exigency of different seasons, and changes of external temperature and climate. Those calculated to avert the baneful consequences of the latter are such as are calculated to promote healthy conditions of barracks, huts, and hospitals; and to invigorate the constitutions of the men under command by well-regulated systems of diet, clothing, exercise, amusements, education, and punishments. In endeavouring to fulfil a promise I made, at the conclusion of my last year's lecture, to embody some practical recommendations and rules in reference to varied causes of disease, and with the object of preserving the health of troops, I shall now point out the practical measures most suitable for preserving the health of military and naval masses, in accordance with the principles of medical geography, which have been brought before you.

In 1821–30 the mean annual proportion of deaths for the entire Prussian army was 11·7 per 1,000 men, a very low ratio of mortality compared with other armies. This army is, however, composed of young men compelled only to three years' active service, and subject to but few changes of locality. The civil population of Berlin, at the same age, twenty to twenty-five, gave 10 deaths to 1,000 living. But the British army in 1819–28 furnished 15 deaths per 1,000 in the United Kingdom, 57 in troops serving beyond its limits, and 37 for the entire army. Taking the mortality of the British army within the kingdom at 1, it is 1·3 beyond the tropics, and 4 in intertropical regions. The present condition of the British navy demonstrates irresistibly the power of *hygiene* in diminishing the ratio of mortality. It was 13·8 per 1,000, or from internal diseases alone 11·8, for the period 1830-36, while seventy years ago it was 123, and less than forty years ago, 30. Official

records attribute this improvement to better diet, free ventilation, less severity of punishment, diminution of the rations of spirit, and less money left at the men's disposal. To the more prominently useful sanitary measures in regard to these objects I shall now advert. And, *first*, in regard to

DIET AND DRINK.—I have already given a brief outline of the peculiar physiological condition of well-nourished Europeans, at their first entrance into tropical climates; and have pointed out that with the change of circumstances a corresponding change of their usual articles of diet and drink becomes absolutely necessary, in order to maintain intact the body's organic functions. That, which the majority of individuals would not, in this respect, willingly or prudently submit to, is naturally forced on their acceptance, and against their artificial inclinations. The appetite for animal food is lessened, the inclination for cooling acid beverages in preference to spirituous drinks or malt liquors greatly increased, and the due performance of the cutaneous and other excretory functions, accompanied by gradual abatement of nervous excitement, thus duly maintained; but, should the harrassing nervous irritation and thirst, to which soldiers and seamen under such circumstances are exposed, ever induce them to seek relief from increased potations of fermented liquors, the very opposite of these healthful changes will be the consequence. The excretory functions of the skin and other eliminating organs are suppressed, the circulating fluids rendered more carbonaceous and impure, the nervous irritability rendered more oppressive, and all the symptoms of tropical fever with its dangerous accompaniments established. Colonel Sykes, in his valuable paper on the "Vital Statistics of the Indian Army," has, from the evidence of figures, given explicit testimony to the benefit of abstaining from the excessive use of fermented liquors under such circumstances; and, that when animal food is unsparingly used, and total abstinence from fermented liquors is not observed, the substitution of beer for distilled spirit will be the least injurious of pre-established habits, which proved not unhealthful in colder climates. He rightly associates the comparative healthiness of the Europeans of the Madras army with the increased consumption of malt liquors

by the soldiers of that presidency, and the gradations of mortality of the Bengal and Bombay European troops as partly influenced by the quantity of spirits respectively consumed. "I have a strong conviction," says the Colonel, "that much of European disease in India is traceable to over-stimulus, and that the mortality among the Europeans troops will not be lessened until the European soldier is improved in his habits, until he is made to understand that temperance is for the benefit of his body, libraries for the benefit of his mind, exercise for the benefit of his health, and savings banks for the benefit of his purse."

The diet of soldiers and seamen in tropical climates might be advantageously made a little more varied, by diminishing the proportion of nitrogenous or animal food, and increasing the quantity of farinaceous articles of diet, or of albuminous culinary vegetables. In the cold weather of the temperate zone, and in the polar zone particularly, increased proportions of animal and fatty food, with a moderate allowance of fermented stimuli for drink, either beer or wine, become necessary for the preservation of vigorous health; but if the same habits of eating and drinking be continued in hot climates, they are followed by their natural penalty, rapid disease, and premature death. Many have recourse to stimulants, in the vain hope of relieving the languor of body and depression of mind, which naturally attend a first residence in such climates, but they are soon cut off, the victims of their own imprudence and temerity. Fresh provisions of good quality, or salt meat in small quantities, free from septic tendency, and sufficiently cooked, are absolute requisites for the climates of every zone. The provision of iced sherbets and coffee in regimental canteens, and the introduction into the army of an evening meal for the soldiers, would be useful improvements on the system of diet. If spirits be drank at all, they should be so after being well diluted with common water, or, what is better, with effervescing soda or potass waters.

We cannot, moreover, doubt the pernicious effects that follow the habitual use of foul water, whether in camps or cantonments. The continuous introduction, from this source, of septic matter into the system predisposes it to be acted on by other morbific causes, even should this itself not become an exciting cause of disease. In tropical

climates it is either raised from wells, or obtained from tanks in which rain-water is collected. In either case it is impregnated largely with animal and vegetable matter, and becomes quickly fœtid and putrescent. Remedial measures for correcting these evils are simple, and not expensive. These are,—keeping clean the reservoirs, boiling the water, and filtering it through charcoal. Small additions of wine or spirit to bad water may be sometimes advisable, but its purification is the more salutary process, as the action of alcoholic drinks on the blood, assisted by increased temperature, is to devitalize this pabulum of life.

Dress.—With regard to *dress* or *clothing* for soldiers and seamen, it is desirable that this also should be suited to the climatic conditions of the different zones. The furs and woollen clothing which are so well adapted to retain the body's animal heat, in the temperate and polar zones, are altogether unsuited to its conditions in either tropical zone. It is not necessary that, in this matter, appearance should be altogether sacrificed to convenience, but surely it is quite unnecessary that, except on parades, either officers or soldiers should be buckled up in woollen clothing on all occasions, or that seamen in the performance of their ordinary duties, with the temperature at 96 to 100 of Fahrenheit, should be clad as under a polar sky. For hot climates a cool linen dress, made according to a pattern, should be officially sanctioned, so that one of the most common causes of disease, sudden refrigerations of the body, after excessive perspiration from over-clothing, might be prevented among the men. It is impossible to prevent soldiers from throwing off their coats to cool themselves after a march, drill, or parade, and the addition, therefore, of a flannel under-waistcoat, or flannel undress, must be at all times, in warm climates, an important addition to the soldier's dress. But defective clothing again of the soldier or seaman in cold climates, is frequently a main cause of their ill health, particularly when predisposed to pulmonary disease. Here flannel under-waistcoats and waistbands should, in general, be provided as absolute requisites; it being kept in remembrance that neither an over-coat nor any amount of extra clothing, in order to preserve warmth, can be a substitute for flannel next the skin, over whose functions it has a special sanitary influence.

In rules for the preservation of health, the benefit of attending to the condition of the cutaneous surface is scarcely second in importance to that of maintaining in healthy vigour the function of digestion. The skin is at once an exhalent of waste matter from the system, a joint regulator with the lungs of the heat of the body, and an agent of absorption amidst surrounding effluvia. Hence the importance of enveloping the body in warm woollen dresses, as practised by the ancient Romans, as the use of flannel next the skin guards against the evils of checked perspiration, regulates the animal temperature in warm climates, and prevents the absorption of deleterious effluvia in malarious countries. The more objectionable parts of the soldier's former dress, his stiff leather stock, heavy shako, and badly constructed knapsack with breast-straps, have been already altered and improved, and every alteration tending to lessen the weight which soldiers are obliged to carry on the march must be received as a boon to them.

Bathing.—External personal cleanliness is in a general way well enforced throughout the army; but the means of general ablution, now beyond the soldier's reach, should be provided for him in every range of barracks of any considerable extent. Warm and tepid bathing is of the first importance, as tending to preserve the healthy functions of the skin, both in tropical and temperate climates. It enables the body to accommodate itself to the changed conditions of new climates, until it becomes acclimated, and impowers the system to resist the morbific influences of malarious agencies generated in hot countries.

Such are the general means—diet, drink, dress, and bathing—for enabling the constitutions of soldiers and seamen to accommodate themselves to changed climatic conditions: and I will now in the *second place* notice the hurtful agencies to which military and naval masses may be exposed, and the best modes of neutralizing them. The most noxious of these agencies are found associated with the sites of barracks, hospitals, huts, and encampments, on shore; or the state of the round houses, sick berths, and hold of ships at sea. But, while each of those individual subjects might claim a lengthened notice, I must now briefly confine my observations to the morbific agencies which render these localities hurtful. Among these are low,

swampy, filthy, confined, ill-ventilated spots, producing malaria; insufficient breathing space in, and defective construction of, barracks, huts, and hospitals.

Barracks.—Medical topography is a most important branch of military hygiene, as it leads us at once to consider the various physical agents which influence the health of the soldier, and to remove him, when practicable, from all causes of endemic disease. In selecting sites for barracks, however, the military capabilities of the locality, rather than its sanitary fitness, have been usually thought of. The opinions of commanding officers, and of the engineer department, have consequently, on such occasions, been more sought for than those of medical officers. But it is the interest and the duty of Government to quarter troops in the most healthy places that can be found, provided always that such selections are compatible with the requirements of the service. Elevation and dryness of locality, free from exposure to strong atmospheric currents from the land or sea, may be looked on as two most important requisites for a barrack or hospital site. In the land service, a large amount of the mortality in the tropical, and even in the temperate zone, may be fairly attributed to the swampy and ill-drained condition of the localities where barracks, hospitals, and military stations have been established. In India I have known a station selected for a regiment of dragoons, where the Government, after going to great expense in constructing barracks, hospitals, and stables, and allowing the regiment to bury twice its average strength in the course of twelve years, ordered the locality to be abandoned and the buildings destroyed. So at sea, much of the sickness that has decimated ships crews in the West and East Indies, and on the shores of Africa, may be accounted for by the miasmatic emanations given off from the accumulated filth of the ship's bottom. Such emanations are doubly vigorous in poisoning the systemic blood, and producing fevers of the most fatal type, when on shipboard the air is imperfectly renewed from above, or in land-locked situations where the atmosphere is stagnant. It is vitally important, therefore, that before any permanent station, hospitals, or barracks for troops be established, measures should be taken for obtaining full topo-

graphical information as to the salubrity of the locality, with the physical qualities of the climate and water; and what influence they usually exert on the health of man and animals.

The ground on which such buildings are placed, whether flat or elevated, should be thoroughly drained. The removal of the surface drainage and animal excreta is more important in the tropical than in the temperate zone; as the decomposition of animal and vegetable organic matter in the soil is rapidly promoted by the influence of high temperature, and becomes a most powerful source of morbific agency. An efficient system of drainage and building is capable of completely altering the unhealthy character of swampy localities: so that Bombay and Demerara, once in as bad repute as the shores of Africa, but now drained and covered with buildings, rank among the healthiest of our tropical colonies.* The beneficial results that have followed from quartering the white troops in Jamaica at Maroon Town and Newcastle, where the ratio of mortality is from 2 to 3 per cent., instead of at Port Antonio, Montego Bay, and Up-Park Camp, where it exceeded 14 per cent., are facts patent to all.

Two of the most important points to be attended to in connection with barracks, hospitals, and huts, are to avoid over-crowding, and to obtain proper ventilation. The first object may be attained by building rooms of a proper size and height, and by allotting them, not according to the superficial extent of the flooring, but according to the cubic contents. Sarlandiere, in his Military Surgeon's Vade Mecum, urges that not less than 1307 cubic feet should be allowed for each man; but we fear that this ample space will never be allowed to soldiers, either in barracks or hospitals. Our prison inspectors allow 1000 cubic feet for each prisoner, and Tredgold on Ventilation deems 600 to be necessary for the preservation of health. The medium of these two quantities, or 800 feet, should be adopted as the minimum for temperate climates, and 1000 for that of tropical ones. A large amount of disease among soldiers is justly

* The unhealthiness of some of the East India barrack sites, as those of Colaba and Secunderabad, from retention of the surface drainage, is well known. But to the credit of the Directors of the East India Company, it must be said that they have ordered all barrack buildings for the future to be raised on arches.

attributable to the continuous breathing of the vitiated atmosphere of over-crowded barracks, hospitals, and huts; and Colonel Tulloch, in his Statistical Reports of the British Army, has shown that crowded barrack rooms, in tropical climates, are not less influential than restriction to salt diet, in producing increased mortality from consumptive diseases.

In regard to ventilation, after all that has been written and recommended by Dr. Reid and others on this subject, the main object to be obtained is a free circulation of air around the building, so that it may be preserved from damp, and be entirely isolated from other buildings.

On the subject of *duties*, *exercise*, *amusements*, and *education*, my remarks must now be very brief; having already occupied so much of your time and patience. Night duty, particularly in tropical climates, should be reduced as much as possible, so that soldiers should have at least four nights in bed; for otherwise, and particularly when they are exposed, even in climates of the temperate zone, to cold and wet in the trenches during a siege, their health will invariably suffer.

Under the head of *exercise* may be included parades, drills, and marches; and no more fertile source of predisposition to disease exists than in the excess of any of these objects,—beyond the physical capabilities of the soldier. Doubtless, long marching in warm climates has been often overdone, so as to render men generally the victims of cholera and tropical fever; and in no part of the military economy of regiments, or armies, may the sound judgment of commanding officers be more usefully displayed, than in the proper regulation of marching or other exercise for the soldiers.

I will not at present enlarge on the amusements, education, and punishment of soldiers; but, in reference to the whole subject, shall conclude by the following medico-military recommendations, promulgated at Burgos, in May, 1823—when the French army was advancing into Spain.

1. The soldiers always to wear their cloth trousers during the prevalence of cold weather.

2. Not to be permitted to undress on arriving at the halting-place, or at their bivouac in the evening.

3. To wear their over-coats whenever the air is chilly, and when they are not on the march or working.

4. In wet weather, to halt for the night on ground a little elevated, sloping, and sheltered from the wind.

5. To increase in such cases the number of fires, and to keep them up till the time of starting.

6. In wet weather to make a distribution of brandy on starting and on arriving at the bivouac.

7. In hot weather, to march the troops early in the morning, or in the evening, resting during the middle of the day in sheltered places.

8. When linen trousers are permitted to be worn, to make the soldier put on a girdle of cloth or woollen stuff round the belly.

9. To make frequent halts, selecting places where the water is good; and to take care that the men do not drink cold water when greatly over-heated.

10. To give them regular exercise when in cantonments.

11. To be careful that their clothes and shoes are kept up and repaired.

12. When compelled to use bad water, to mix a little vinegar or brandy with it.

13. In marshy places, to encamp, if possible, on high ground.

I have thus imperfectly endeavoured to apply the principles and means of medical geography to the preservation of the health and efficiency of our soldiers in foreign climates. But in regard to the removal of men from one climate to another, their regimen, dress, dwellings, and drill-exercises, statistical results are yet to be collected, and made useful, as the foundation of practical deductions, for our future guidance in everything relating to the British army and navy, as well as the East Indian armies.

July 10th, 1857.

COLONEL THE HONOURABLE JAMES LINDSAY in the Chair.

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## ON THE RIFLE; SHOWING THE NECESSITY FOR ITS INTRODUCTION AS A UNIVERSAL INFANTRY WEAPON.

Being the substance of a Lecture delivered at the United Service Institution, by LIEUT.-COLONEL WILFORD, Chief Instructor, School of Musketry.

Mr. Chairman, Gentlemen, and Soldiers,

I am permitted to address you on the subject of Musketry, and I shall—

1st. Endeavour to show the necessity for the introduction of the Rifle as a universal infantry weapon.

2d. The mode by which it is now being introduced into the British Army.

3d. The advantages which must ensue therefrom.

4th. I shall advert to some objections urged against it.

Although my subject trenches upon the history of arms, the theory of gunnery, and military education, and knowing that it is too comprehensive and important to be properly dealt with in a single lecture, I must crave your indulgence, and I shall endeavour to be brief.

1st. As to the necessity for the rifle as a universal infantry weapon:

Before proceeding, I must pay a tribute to "Brown Bess," and willingly confess that it was a very formidable weapon at *short* ranges, owing to the steadiness of the British soldier when under fire, using such a heavy gun, large charge, and ball. Its deadly fire in close combat, in the Peninsula, at Waterloo, and in India, has been borne honourable testimony to, by those against whom it was directed. Nevertheless, partiality must not be suffered to blind us to the defects of our old friend; for, with the bayonet fixed, it was the

*shortest* gun used by any European army; at the same time the *heaviest;* it had the *most windage*—fired the *largest* charge of *powder*—it had the *greatest* recoil—the *least* accuracy. It was folly to attempt to fire with it against small, or at all distant, objects; and the British soldier found himself almost powerless when contending with *half-clad savages* or *semi-civilised* enemies. Beyond 80 yards it lost *all* certainty of hitting a *single* man, at 200 yards it was uncertain even at larger bodies, and when screwed into a block or fired off a rest, you might shoot *all day* at a target 300 yards distance, and 18 feet square, and *never* strike it *once;* so that a man might be in *perfect security* if fired at from sunrise to sunset, at even a less distance than 300 yards, provided the firer made a faithful promise *always to aim at him.* How, then, I may be asked, were our former victories gained? Truly: British infantry have nobly played their part in gaining victories over enemies who were armed with muskets *nearly as bad* as their own; they conquered *with* Brown Bess, not *through* Brown Bess; but rather, they earned honours in spite of it. The late Lieutenant-General Sir George Cathcart, upon whom lay the onus of the Caffre war, wrote to be furnished with such means as, in his judgment, might bring that inglorious transaction to a close, and cut short the Caffre Bill. What do you think he asked for, gentlemen? Three thousand Swiss! Did this English General think Swiss more brave or better disciplined than Britons?—himself pronounced by our gracious Sovereign to be a hero, of a family of heroes! Did he intend to disparage those, his brother soldiers, whom he had the honour to command? Most assuredly not: but he felt a vacuum England's army could not fill,—Switzerland and the Tyrol being the only two countries which could supply the kind of soldiers he required, viz. such as could fire at *small objects with accuracy at long ranges.* On one occasion at the Cape, it was calculated that after firing 80,000 rounds, 25 Caffres were killed, being in the proportion of one Caffre for each 3,200 rounds; and the probability of hitting a man at 500 yards, is as one farthing to 800 millions of pounds,—the National Debt of Great Britain! All men have a way in which they prefer fighting, and Caffres rarely select a piece of open country to try a little bayonet work; so that, unless they can be hunted

like hyenas, war with them may last for ever! What a melancholy object does a civilised soldier present, when loaded like a mule, and armed with a gun which will throw a ball with some certainty about the distance a man can throw a stone, pursuing an enemy who carries little more than his skin upon his back, and to whom every rock and tree is a fortress! In a pamphlet by Colonel Jacob, "Bombay Artillery," he says:—"Man has been called a tool-making "animal; and it is a certain mark of advancing civilisation, of the "progress of mind over matter, of the development and operation "of those laws by which the working of the human brain makes "the force of one civilised man equal to that of the stalwart limbs of "thousands, or even millions, of untaught and ignorant barbarians. "To no people on earth have tools and machinery been of more "importance than to the English. It has been said that it was "the spinning machinery of Arkwright which enabled England "so long to stand alone, and successfully, against the world in arms. "If such be the value of the tools employed in the arts of peace, "those used in war must be even of more consequence. The "military art, like all others, can only approach towards perfection "by the use of the most perfect tools and machinery attain-"able. Yet, notwithstanding this certain truth, it is notorious "that the inferiority of the arms used by modern English soldiers "was, for long, a disgrace to the intelligence of the age, and an "outrage on common sense, when compared with the high state of "perfection to which the manufacture of arms, as of all other tools "and machinery, has been brought in England." Until recently we had four battalions of Rifles, and also Canadian, Ceylon, and Cape-mounted Rifle regiments, but their weapon (the Brunswick two-grooved) after most extended experiments at Antwerp in 1844, was deemed to be the worst in Europe. The French had for a long time discontinued rifles in their armies, thinking that the time lost in loading was not compensated for by their comparatively increased accuracy. The inefficiency of the smooth-bore musket is shown in the most marked manner by the number of years it has taken our French allies to subdue the native tribes of Algeria, as fighting may be said to have just closed there after about 30 years' duration. The French, finding themselves unequally matched against Arabs and

Kabyles, who had a range and accuracy unknown to the French infantry, attempted to place themselves upon equal footing, by carrying wall pieces (the hand-gun of 400 years ago), and afterwards they sought to effect their purpose with light artillery; but these not proving satisfactory, they turned their attention back to the rifle. The French army now includes some thousands of chasseurs armed with rifles, and I believe that the expense is the only bar to their universal introduction, as they happen to have in use and in store some 700,000 smooth-bore muskets. Fortunately we have not our neighbours' difficulty to contend with, as between 200,000 and 300,000 Brown Besses were burnt to a cinder one fine morning, with other rubbish and cobwebs, in the Tower. I hope the quarters where naughty people were placed in former times were burnt down at the same time, lest some one I know should be thought worthy of incarceration. The Prussians have many thousands of their infantry armed with a breach-loading long-range rifle. The Russian army is to have 54 rifle regiments, with a rifle company to each other regiment of infantry. The Austrians are busy at work, according to their means. The Tyrol has always supplied them with a large number of marksmen. The Belgians are, I believe, universally armed with rifles; and even the little kingdom of Portugal has ordered 28,000 rifles from Belgium. Thus, whether we shall universally arm with a rifle or not, seems to have been settled for us by their adoption into foreign armies, as we must either place ourselves upon an equality, as to armament, with those against whom we may have to contend, or lie down in the gutter, content to allow our enemies to ride over our heads roughshod! I shall now describe, by way of contrast, the performances of the Enfield rifle. It is 2½lbs. lighter than the old musket, has a smaller bore, fires a heavier projectile, it is stronger, has only ·009 windage, uses only 2½ drams of powder, has little or no recoil, and it is sighted up to 900 yards. It can be loaded with the celerity of any smooth-bore, but possesses an accuracy far beyond what Brown Bess or the Brunswick rifle could attain. An experiment was made at Hythe, in which 35 men, skirmishing in marching order, fired 30 rounds each, advancing and retiring at distances between 820 and 550 yards, at two targets, the one 50 yards in rear of the other, each

having a frontage of 30 yards, equivalent to 35 files: the targets were six feet in height, and the distance between the two was equal to that of a battalion column at quarter distance. There were 617 hits out of the 1,050 rounds—the men engaged had to judge their own distance. Had there been six intermediate targets to represent the other companies, it is not too much to suppose that they would have had at least 200 more hits; so that, out of the 1,050 rounds, about 800 would have told upon the column. On another occasion, 30 men were arranged in skirmishing order, and fired at a group representing a fieldpiece coming into action (stuffed figures of horses and men of the ordinary size); the firing was stopped at two minutes, when it was found that each man had fired two rounds; when of the six horses and eleven men, including the three mounted drivers, the six horses had twenty-two balls in them, and seven of the men were also struck. This trial was repeated at 815 yards; five out of the six horses had sixteen hits, and six out of the eleven men had eight balls! At this second trial the time was extended to three minutes, when it was found that the front rank had fired three rounds, and the rear rank two. Had one rank not waited for another, but had both fired together, the same execution would in each case have been done in half the time. In volleys at a frontage representing a section of a company—targets six feet high; at 300 yards, 90 per cent. hits; at 400 yards, 76 per cent.; at 600 yards, 52 per cent.; and at 800 yards, 25 per cent., were obtained by soldiers who had only undergone one course of instruction at the School of Musketry. At individual firing the results are equally surprising: an officer of the 1st West India Regiment recently hit the target seven times out of eight consecutive shots, three of which were fired at 850 yards, and five at 900 yards.

But the rifle invented by Mr. Whitworth (and which has been tried at Hythe) as far outstrips the Enfield, as the Enfield does the Brunswick; and experiments are now in progress at Woolwich, to see how far it may prove suitable for a military arm, and more fully to test its merits. Opinions are more or less valuable according to circumstances, but facts are stubborn things, and, if killing your adversary be any test of a gun, there cannot be much difficulty in determining the comparative merits of any arm. The Whitworth

will fire better at 800 yards than the Enfield at 500: beyond 1,100 the Enfield must "cease firing," while Whitworth's can do business at 2,000! Indeed, rifling seems to be in its infancy, and range must only stop, with the powers of the human eye to take an aim. Breach-loading rifles have also been invented, from which there is not the slightest escape of gas, and which can fire ten rounds in one minute. The continuance of their fire will only be restrained by the exhaustion of their ammunition, or the rifle becoming too hot to hold.

Allow me to read an extract from a recent number of the Times, as follows:—"What is a Rifleman? He is simply an infantry "soldier, equipped with a fire-arm, and therefore differs nothing, "upon a first presumption, from any other soldier in the line. "But his equipment differs in quality, if not in kind. His weapon "is constructed especially for long and accurate shots, and he is "trained to manœuvres, teaching him how to improve every advan- "tage of ground or position which he can find. That in these "respects he may be better than an ordinary soldier is very true, "but why need the ordinary soldier be left in this position of in- "feriority? Why should not every soldier in the line be provided "with a firelock as good as can be manufactured, and taught to "use it as cleverly as a sharpshooter? A rifleman, after all, is "nothing more than a musketeer, armed with a musket which will "kill, and one musket ought to do this as well as another. Take "a parallel from times long past, when the favorite weapon with "the Englishman was the bow. We do not read in those days "of any company of archers provided with particularly good "bows or arrows, or expected to shoot with particular accuracy. "Every man had as good a weapon as could be found, and en- "deavoured to use it as well as his neighbour. If, in an army of "100,000 musketeers, 10,000 can hit the mark, while the others "cannot, they become of course a corps of peculiar utility; "but their superiority would vanish when the other 90,000 "became marksmen of equal merit. If the rifle, or effective "musket—for the rifle is nothing else—were ill-adapted to general "service, it would be another matter; and, as every man alike "carries a firearm as his weapon, there can be no reason why one

" should not be as well equipped and as well trained as another,— " why the greatest available efficiency should not be imparted " *to all*. In our opinion, it is better to make every soldier in the " army a good shot, than to assume that most of them will be " bad ones, and provide special battalions for compensating the " defect. In this respect, every battalion should be special, and to " such an end we hope our own organization is now tending." I confess that I entirely concur in the sentiments contained in the foregoing quotation, and happily our rulers have determined that every British soldier shall be "*special*," and a rifleman. Thus we, having the kernel, need not trouble ourselves about the shell,—so that whether some regiments shall have short rifles, and long swords to interfere with their running, or longer rifles and short bayonets, does not much matter. If for "auld lang syne" the most conspicuous colour, viz. black, be preferred by some, let them wear it. Riflemen can only be made such by teaching,—they are not born such, though some learn quicker than others. In the English army, a soldier cannot be made to serve in any regiment contrary to his own will; and to extract the good shots from one regiment and place them in another, *vice* an equal number, whose *only* fault was that they could not shoot, would be submitted to by the colonel about as gracefully, as if you were to extract a tooth a-morning, till all were gone, and furnish him with a pretty, white, new set with which he could not masticate. Happily, no English colonel will ever be called upon to command a *weeded* regiment.

Thus, I trust I have shown the necessity for the introduction of the rifle as a universal infantry weapon: first, from the insufficiency of the old musket; secondly, because foreign armies are largely introducing it; thirdly, from the astonishing powers of the rifle in the hands of a *taught* soldier.

2ndly. Before proceeding to show the mode by which the rifle is now being introduced into the British army, I shall briefly refer to the manner in which firing was taught hitherto;—and here, strange as it may sound, although the name musketeer implies a soldier who destroys his enemies by firing out of a musket, and sticking with a bayonet, yet how to perform these with the greatest effect were the *very two* things he was never taught. Being placed in position

to commence firing or to charge, the soldier was left to his own resources; virtually, in firing, he shut his eyes, opened his mouth, threw his head back, and pulled the trigger; and, as if this was not enough, he was sometimes exhorted to "aim low." His feeling commander, being so supremely ignorant, might just as well have said: "You see those poor fellows?—do not hurt them—aim low!" an almost certain mode to insure their balls flying over the heads of their opponents, as any ball will ricochet at the same angle with which it strikes the ground. There was a *thing* called ball practice; it was looked upon by all parties as a bore, hurried through as a form, almost universally, as there were but very few bright exceptions, being the infinitesimal minority of officers, who thought their men were intended to hit when they fired off balls! How can anything be practised which has not been *previously* taught? Ask a man to practise the fiddle, who does not know a note; or to dance a polka, who has never been taught a step. Hence our ball practice was, in most cases, little better than a farce, and if the calico target did not look sufficiently satisfactory to be carried in triumph into the barrack yard, the drummer well knew that he had only to drive a few holes through it with his drumstick to make it "all right." It is true that the "Infantry Manual" contained most valuable instructions for firing, but these were almost a dead letter for want of detail, while it must be admitted that, from the wretchedness of the gun, it would not have paid for the trouble of teaching; although, had the instructions been complied with, firing would certainly have been much better than it was. Our new gun requires a new man; as Colonel Jacob says, "a skilled workman, not a pipe-clayed automaton." With this view, the late Lord Hardinge, who introduced the Enfield rifle, established in 1853 a normal school of musketry at Hythe, in order to qualify the soldier to use it. Detachments of different regiments are sent to that establishment to go through a course of training, which occupies about ten weeks, in order that each regiment may be supplied with a qualified officer and non-commissioned officer instructor in musketry. The instruction is divided into theoretical and practical—the latter into drill and practice. The object of theory is to give the reasons for everything that the soldier may be afterwards called upon to perform in

practice; and it is taught by lectures, diagrams, models, and by catechising. There are four drills, viz., cleaning of arms, target drill, judging of distance drill, and the manufacture of cartridges; target drill being divided into aiming and position drill. The most minute attention is paid to each individual soldier, and he is taught to fire in *drill*, balls being afterwards used in practice merely as a test of the soldier's proficiency. A man cannot be made to hit a mark against his will, in fact, he fires with his brains, the eye and finger being merely servants of the mind. To succeed or to excel, there must be love in the heart and knowledge in the head, but no man can be interested in that which he cannot understand. Hence, each soldier is made to comprehend the laws which influence the bullet in its flight, and how to apply this knowledge to practice. He is led to think, and his moral character is found to be improved and elevated thereby. He becomes conscious of his increased efficiency and value; he is raised from a mere machine—a trigger-puller—a thrower away of fire—and, after instruction, is not merely a good, but an intelligent shot. It has been satisfactorily proved, that taught soldiers beat untaught officers, but taught officers will excel taught soldiers. A regiment, on the old system, never improved, year after year, in firing ball, while a taught regiment fires better each succeeding year. Sportsmen are generally beaten by taught men; to their annoyance and surprise, they cannot hit an iron target, but refer to their performances at bogs in Ireland, or jungles in India. The officers are put through precisely the same amount of drill and practice as the private soldier, each snapping caps, firing twenty rounds of blank, and 110 rounds of ball, in individual firing, file and volley firing, and skirmishing, in which they are exercised as soldiers; but in addition (being attached to sections and classes, when they act as officers) they are taught *how to teach*. A series of lectures, eight in number, is delivered and explained to them, upon which, and upon the whole course of instruction, they are catechised and examined in presence of the commandant, at the expiration of the term, preparatory to receiving certificates. The eight lectures treat of the theory of gunnery, the history of small arms, the history, manufacture, and explosive force of gunpowder; of these each officer is required to take a copy.

Thus in each regiment of the line it is intended that there should be at least one intelligent officer, possessing a fund of most important information connected with the efficiency of a rifle regiment, and to whom is entrusted the duty of aiding his commanding officer in furthering the efficiency of his regiment, by instructing the officers and men in the theory and practice of musketry. I trust I have sufficiently pointed out the mode by which the rifle is being introduced into the British service.

3rdly. As to the results which must ensue.

Actual and varied warfare can alone fully demonstrate the consequences of war carried on with such amazingly increased powers of destruction placed in the hands of the infantry, who have ever been numerically the strongest portion of modern armies; and it will depend upon the talent of commanders to avail themselves fully of these powers. Unquestionably the whole system of tactics and fortifications must undergo important modifications, from the altered relative value of artillery, cavalry, and infantry. I shall not presume to dictate how our new infantry shall be best employed, but I can state what their powers *will* be. My duties lead me to deal with units, whose value becoming increased in proportion to the amount of instruction, we arrive at sections, companies, regiments, brigades, and divisions, until the whole infantry of our army can shoot at long ranges. Should two rival armies take up their position at a very short distance, and choose to take issue with the bayonet, in this case, a pike might answer all purposes even as well as a musket, much less a rifle. But the long-range rifle will tend to keep armies at a more respectful distance. Unquestionably in all the minor operations of war, in desultory warfare, in the defence of posts and field works, in clearing out embrasures, mantelets and gabions being fired through, the lines of defence in permanent works being lengthened, infantry rendered less dependent for support upon artillery, advancing columns and field batteries being reached at 1,000 yards, and thus be for a long time under a destructive fire,—in all these cases the rifle will play a most important part. A taught regiment of 800 men could throw 16,000 bullets in ten minutes into a fort of an area of 50 square

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3rdly. As to the results which must ensue.

Actual and varied warfare can alone fully demonstrate the consequences of war carried on with such amazingly increased powers of destruction placed in the hands of the infantry, who have ever been numerically the strongest portion of modern armies; and it will depend upon the talent of commanders to avail themselves fully of these powers. Unquestionably the whole system of tactics and fortifications must undergo important modifications, from the altered relative value of artillery, cavalry, and infantry. I shall not presume to dictate how our new infantry shall be best employed, but I can state what their powers *will* be. My duties lead me to deal with units, whose value becoming increased in proportion to the amount of instruction, we arrive at sections, companies, regiments, brigades, and divisions, until the whole infantry of our army can shoot at long ranges. Should two rival armies take up their position at a very short distance, and choose to take issue with the bayonet, in this case, a pike might answer all purposes even as well as a musket, much less a rifle. But the long-range rifle will tend to keep armies at a more respectful distance. Unquestionably in all the minor operations of war, in desultory warfare, in the defence of posts and field works, in clearing out embrasures, mantelets and gabions being fired through, the lines of defence in permanent works being lengthened, infantry rendered less dependent for support upon artillery, advancing columns and field batteries being reached at 1,000 yards, and thus be for a long time under a destructive fire,—in all these cases the rifle will play a most important part. A taught regiment of 800 men could throw 16,000 bullets in ten minutes into a fort of an area of 50 square

yards, at a distance of 900 yards; and this could be done over the heads of a column advancing to storm. With such startling facts, showing the mighty change which must take place owing to the efficiency of infantry, one cannot but be surprised at the silly, indeed the almost rancorous, spirit of controversy, with which the introduction of the rifle is attempted to be opposed. One might almost suppose, in treating of the powers of our weapon, that we are longing for a tilt against our artillery brothers on Woolwich Common, while all the time we are only thinking of making short work with our Queen's enemies. Every patriot cannot but rejoice on finding that there are improved means of securing the duration of peace, and curtailing the evils of war; whether it be by improving the sabres or lances for our dragoons, the ships and armament of our navy, the guns of our artillery, or by the rifles of our infantry and marines. It is well that each branch of our service should be "well up" to what is going on in the others; and as foreign nations are "wide awake," our artillery and dragoons may as well "look out for squalls," for they may safely anticipate a brush with long-range accurately-shooting infantry. It is too late to deny facts; and to "go a-head" is doubtless the order of the day with each and all of us. The English army must ever be a small one; our object therefore should be, to make up by efficiency for what we want in numbers. While no expense should be spared in perfecting our arms and ammunition, so, also, too much pains cannot be taken to qualify the soldier effectively to use his improved weapons, ever remembering that the good gun is worse than useless in the hands of an untaught man. It is right to have a sufficient supply of first-rate rifles in store, but if we trust to them for safety, not knowing where to find intelligent men to use them, we are leaning upon a broken reed; it is not to the weapon, *but to the user of it*, we must trust for the protection of our throne, our altars, and our hearths! Was it English bows that gained immortal honours for English infantry at Cressy, at Poictiers, or at Agincourt? No, it was English *bowmen*. Were slings from the Balearic Islands better than those made at Rome? No, but the *slingers* were. John Bull consoles himself by knowing that "wooden walls" surround his "sea-girt isle," but for myself, my

gratulation increases when I hear about the "hearts of oak" to stand behind those walls. Some weeks since our friend John was assured that there should be no needless call upon his pocket, as the line was pared down to the ante-war standard, but that there should be lots of rifles in the stores, and large numbers of militia (at their ploughs), who at the end of three weeks could be made perfect soldiers, and fit to be employed for the defence of Mrs. and the Misses Bull. If by a soldier is meant a man in red, who can march without treading down the shoe-heels of one in front, well and good; but if you mean to convey the idea of one skilled in the use of a rifle, perhaps three years would be nearer the mark. The maximum of efficiency, with the minimum of instruction, could be best got out of a pike, a weapon one stage a-head of the broom-stick, and the one I would recommend to be placed in the hands of your three-weeks' men. Although my opinion as to the consequences which must ensue from the introduction of the rifle can have no weight, I am fortunate in being enabled to refer you to the opinions of officers of artillery. Colonel Jacob, to whom I have before alluded, writes:—"Judging from our practice, it seems "certain that two good riflemen so armed could in ten minutes "annihilate the best field battery of artillery now existing." "The "army which should first adopt these weapons would thereby obtain "an advantage equal to that of the exclusive possession of fire-"arms a century ago. One effect of these would be that the whole "of our field artillery would become totally useless." "Train and "arm the men worthy of their noble nature, and 50,000 such "soldiers would be a match for a world in arms." "Any numbers "or mere masses of semi-barbarous enemies, aye, or of ordinary "soldiers, would be powerless against such foes. Cavalry would "become of little value against such infantry, and our present "artillery absolutely useless against them. With open files and "ranks, each man a skilful combatant, but still all acting in "perfect concert, as would be easy with such brave, trusty, and "intelligent and skilful men, they would sweep their enemies from "the earth, themselves almost unseen; while a single discharge from "a company at 1,000 yards distance would annihilate the best "field battery now existing. The value of individual skill and

"practice would be immensely greater than under the present "(1855) system. No amount of mere 'food for powder' could "successfully oppose even a small force so formed; opposition to "the English soldier would become as impertinent on land as it "has been said to be by a celebrated French author to our seamen "on the ocean. With such infantry so armed our artillery must "be abolished or improved."

I shall now read to you a few extracts from a work, entitled "Constitution Militaire de la France," written by Paixhan, a General of French artillery, and translated into English by Major-General Brereton, Royal Artillery. "Napoleon has said that the musket "is the best warlike machine invented by man; what would he "have said if he had seen the new arm? What the consequences "of this change will be, it becomes of importance to examine. "At 600 metres the enemy's case shot will scarcely range, and his "round shot will only hit a group of two or three men six times "out of 100 rounds, but at that distance our infantry can make "every shot tell upon the vast group of men and horses in action "with a gun. The enemy's artillery must soon be silenced. Thus, "on both sides, if a battery of artillery be placed in line, and in "advance, and if a company of light infantry be placed in front of "it, there will probably be a complete extinction of fire of artillery. "No doubt the cannon will always retain its superiority in pene-"trating deeply into the heads of columns, in clearing obstacles, "and in acting at considerable distances; but the fire of light "infantry will have a terrible effect against field batteries; and a "swarm of light infantry upon the whole line, firing with such "exactness, what will not be its effect upon an enemy's troops, "upon its masses, and upon its officers, who will be selected as "objects by the most practised of the marksmen? Doubtless, "the more effectual an arm has been rendered, the more skilful "should be the man who is to use it. Thus this new arm—a "French invention—will not only be favourable to France, but "also to all defence against attack; it will be in favour of the "weak against the powerful; favourable to independence, to the "rights, to the peace, and the dearest interest of every nation. "Now that the musket has been rendered capable of striking a

" group of two or three men six times out of 100 rounds at a " distance of a quarter of a league, and that at 200 metres every " shot takes effect, it is evident that constant firing, and more " especially the meeting of line against line, column against column, " will become less frequent—that a change will take place in battles " and manœuvres." I trust, gentlemen, from what I have now stated and read, that you are satisfied that most important alterations and consequences *must* ensue from the adoption of the rifle musket as an infantry arm, bearing in mind that those intelligent artillery officers, when they wrote, were entirely ignorant of the *vastly increased powers* of the Whitworth rifle.

4thly. I shall now notice some of the objections which have been used against the rifle as a universal infantry weapon. Although it is only six years since the introduction of the Minié, and four since the Enfield, much of the outcry, and many of the objections, have died out; and, indeed, they were most of them so puerile, as hardly to deserve the time taken to repeat them ; to answer such " twaddle " would be worse than waste of time. " Rats and mice were to eat the grease of our cartridges !" " The hole made in a man's body by the bullet would be too small !" " The soldiers would forget to reverse their cartridges from excess of funk !" " They would not be able to judge the distance of the objects." " Courage would vanish by firing at long ranges " (ergo, the rifles and artillery must be cowards par excellence). " Squatting on the heel would spoil a man for charging." " Position drill would make a battalion shaky under arms." It is in print, that infantry soldiers were never intended to play at " long bowls ;" " it is not their business to shoot men a long way off." They must not poach on the manor of a man dressed in blue, with scarlet facings; and, until recently, it was not lawful for a man dressed in scarlet, with blue facings, to shoot an enemy unless with a bullet of spherical form, weight one ounce, powder 4½ drams; and the projectile must " not be a compound," but be made of lead only. " The rifle is too delicate, and not fit to " be put into the hands of a common soldier;" wilfully forgetting that that master mind, the late Lord Hardinge, who placed the Enfield rifle in the soldier's hands, also established the school of musketry, that he might be qualified to use the *best gun which has ever yet*

*been supplied in such large numbers to any army that ever trod the earth;* and every Briton owes a deep debt of gratitude to that great man, who, ahead of his generation, ardently longed that before he died, the English soldier should carry the *best gun that could be made.* But, gentlemen, we do not intend to have a "common" soldier; and I need only point you to the gallery, crowded with infantry soldiers of the Guards, to prove that our men can be interested in their profession, and are willing to be instructed. Let no one dare reproach a soldier with being "common" or ignorant, until he himself shall have used every exertion in his power to enlighten and to make him uncommon: perhaps he is more ready to learn than we are to teach. By calling the rifle "delicate," an aspersion is cast upon the character and judgment of Lord Hardinge, who decided that it was entirely suitable for military purposes. If I knew what was meant by the word "delicate," as applied to the rifle, I should be glad to answer the objection. If fragile or weak is intended, I have authority for stating that, although lighter, it is in reality stronger than "Brown Bess." Perhaps delicacy may refer to the construction or use of the sights. I can only say that I have witnessed the firing of hundreds of thousands of ball cartridges, by all sorts of men, and have never seen but one injured, and that so very slightly, that its use was not in the least interfered with. It is foretold that the infantry soldier will be too much alarmed, from the fire of artillery, to use his sight; but permit me to remind this objector, that artillery can only fire with accuracy from being a judge of the distance, and then by using a sight; and that they are equally subject to fright, being the recipients of a shower of leaden hail, while pouring forth their thunder. A back sight is quite a proper thing for a large gun, fired by a man in blue, but wholly unsuitable for a small gun, and beyond the care and capacity of his brother in yellow facings! This is almost too absurd! A chronometer is, I believe, a most delicate instrument; but I never yet heard that it is too delicate for a sailor. The promised advantages are said to be "overdrawn," and a wise man recently wrote in the Times, that this was proved by the few Russian dragoons who were unhorsed by the rifles of the 93d Regiment at Balaklava. Now, a taught soldier is not in

the least surprised on account of this total failure; but his astonishment would rather have been called forth, had the results been different. Would a gold pen, value 15*s*., write when placed in the hands of little Tommy Hodge, he never having been previously instructed in the formation of "pot-hooks and hangers"?

Mr. Chairman, Gentlemen, and Soldiers, I shall trespass upon your time no longer: permit me to thank you for the patience and fortitude with which you have endured my long-range skirmishing. I fully believe there is a glorious door open for British infantry. I trust that our comrades who have recently gone to India have had some measure of rifle instruction, and that they may give a taste of the Queen's lead to those demons in human form who have eaten the Queen's salt. May the number of officers who are pursuing the army as a profession be daily on the increase, and largely predominate over those who endure it as a calling. May our gracious Sovereign have always at her disposal fifty thousand adepts in the use of the rifle—and, under the fostering care of our Royal Commander-in-chief, may British infantry become as renowned for skill as they have ever been for valour; and may they reap wreaths of laurels with their bullets, to intertwine with those which they have gathered with their bayonets!

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July 17th, 1857.

LIEUT.-COL. T. ST. LEGER ALCOCK in the Chair.

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## ON MILITARY TACTICS.

BY LIEUT. D. C. WALKER, R.E.

### HISTORICAL DEVELOPMENT OF MILITARY TACTICS.

THE earliest mention of combined military operations is contained in the Homeric poems; previous to that time, war can have been little else than a succession of predatory inroads. Yet no common band of discipline united the Greeks under the walls of Troy; each

of the chieftains contributed his band of followers to the common cause, and one of their number was chosen as commander-in-chief. His authority, however, was by no means paramount; indeed he was little more than president of the council of generals that was convened on all important occasions. Nothing like the tactics of a regularly disciplined army is to be traced in Homer's descriptions of battles, which were singularly indecisive in their results; they appear to have taken place constantly, even daily, before the city. The rival chiefs, carried in chariots and clothed from head to foot in defensive armour, met, challenged one another, and fought, and, if one was slain, a victory was considered to have been gained. The mass of their retainers, composing the infantry, was lightly estimated, and but little reliance placed on them. Cavalry was unknown. Thus individual prowess was everything, and the age has been well termed "the Heroic!" As time advanced, however, popular influence increased in the states of Greece; democracies arose; and this change in the civil constitution induced a corresponding one in the military. It was no longer the few mail-clad heroes that decided the victory, but the steady, compact, disciplined *mass*, actuated by the mind and moving at the command of one man. The celebrated Phalanx was the feature that characterised the tactics of this period. It was a mass of men armed with shields and pikes twenty or more feet in length, arranged in ranks in compact array, and led by a variable proportion of officers. These were most carefully distributed in the different parts of the Phalanx, according to their courage, skill, or other military qualities. The strength of the Phalanx lay in the irresistible force with which it bore down in a charge, and the firmness with which it received one; but it changed its front with great difficulty, and, if an attack was made on it during the movement, all was lost. Rough or undulating ground too must have caused great confusion in it, and the rigid inflexibility of its tactics rendered it indisposed to the attack of a position that was strengthened by earthworks or stockades. In a battle the conflicting armies were usually drawn up in two parallel lines, and the engagement began at the same time in all parts of the line. Cavalry and light infantry generally accompanied a Phalanx, but the former was misunderstood, and undervalued in consequence. By degrees modifications crept in;

Epaminondas at the battle of Mantinea charged the enemy's line in column and broke it. Alexander the Great introduced a rough species of artillery into his army, which consisted of machines for throwing stones, darts, &c. But the Romans were the first who entirely abandoned the system of the Phalanx, and adopted a new one, viz., that of the Legion. The organization of the Legion was so ably described by Colonel Macdougall in his lecture on the Genius and Campaigns of Hannibal, that I think it unnecessary to detail it on the present occasion. It will be sufficient to recall to your memory, that the Romans drew up their troops in five parallel lines for an engagement; if the front one was defeated, it retired, passed through the intervals of the other four, and re-formed in rear of them; the second then advanced to the attack, and if necessary retired in the same manner, its place being taken by the third line, and so on. The Romans were also celebrated for their invariable practice of intrenching the positions they occupied, and so much attention did they bestow on this branch of military art that each soldier sometimes carried an intrenching tool in addition to his arms and provisions.

It has often been said that "events reproduce themselves in cycles." The stages of advance in military organization appear to have done so in a remarkable degree. After the decline of the Roman Empire as a single all-powerful state, and before the rise of the different kingdoms which grew out of it, the heroic age almost seems to have returned under the name of the Feudal System; victory once more inclined to the side which boasted the greater number of knights in armour, and battles were fought with almost as little regard to a fixed ultimate object as those of the Greeks and Trojans. Military glory appears to have been almost invariably the sole aim of the combatants. The same causes which had led to the decline of the heroic age gradually sapped the feudal system; but in the latter case the transition was far more rapid, because a new and powerful agent, hitherto unknown, at least in Europe, came into action: this was gunpowder. Previous to its invention a man cased in complete armour could drive a host of ill-armed peasants, for of such materials did the retainers of the feudal barons consist, and the moral power which he derived from this superiority was great. It is true that

masses of English bowmen were brought into play towards the close of this period, and threw great weight into the scale of victory; but this was not the case until late in the feudal era, and the disparity between an archer and a knight was not nearly so great as between a knight and a man armed with a fire-lock. Great was the revolution produced by the introduction of fire-arms into war. The fire of masses of infantry became the most powerful weapon for offence or defence in the hands of a general; a bullet found no impediment in a coat of mail, and the use of the lance rapidly declined: the lofty baronial castles came down, and the raised earthen rampart took their place. Nor was the change confined to warfare; the men who were drawn from the plough and loom to form the army in time of war, were conscious that their value had risen immensely, and the feeling of independence they carried to their homes must have excited a powerful influence on their political condition. Standing armies were the next innovation; and the individual efficiency of the soldier, together with the art of moving masses of troops, improved gradually, until Frederick the Great brought the modern system of tactics to the highest state of efficiency.

### Modern Tactics.

Napoleon defined war in its broad and general sense to be "the art of being the stronger." In what then does the art of being the stronger consist? It consists in placing at a decisive point a greater body of men than the enemy can there oppose to you. This is the fundamental principle on which the art of military tactics depends. But this is not always an easy matter, nor does it follow from this principle that victory must invariably fall to the general who has the greater number of men at his disposal. His position may be intersected by a ravine or wood or other natural obstacle which may impede his lateral movement, whilst that of his opponent is clear. Thus in fig. 1. pl. 1, supposing B to be an army of 20,000 men divided into two portions by a ravine or river R, R, and A an army of 15,000 men in one body, it is evident that the general commanding the army A may leave 3000 men to hold in check one portion of the army B, whilst with the remaining 12,000 he attacks the other; and many other circumstances of a similar nature may and

Pl. 1.

Fig. 1.

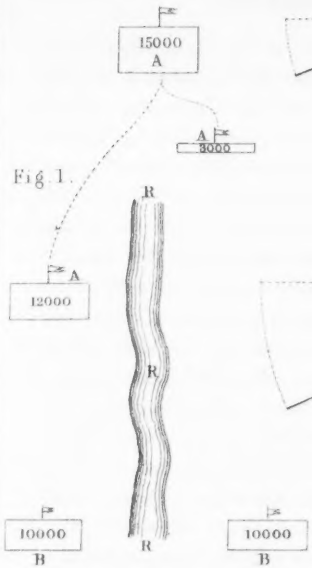
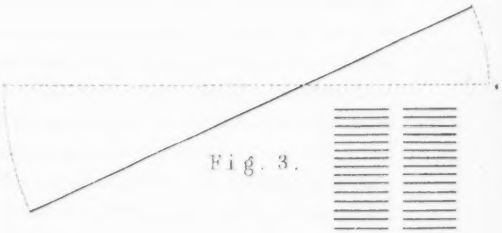



Fig. 2.

Fig. 3.



Pl. 2.

Fig. 1.

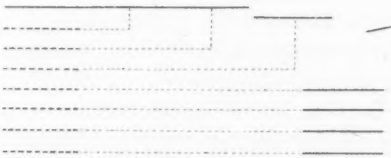


Fig. 2.

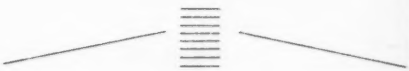
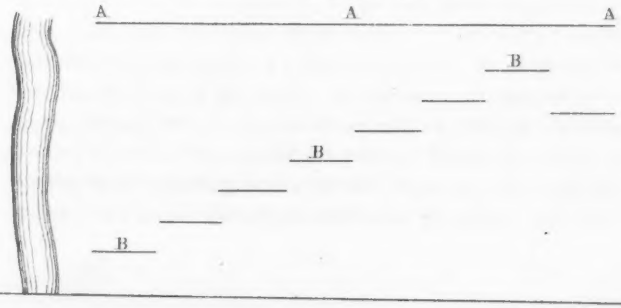


Fig. 3.




J.R Jobbins.

do occur in actual warfare. It is also evident that an army to obtain the above-mentioned advantage must possess the power of moving and of altering its disposition with facility. Now the handling of 20,000 men is a serious matter; to effect it without confusion, one man must direct its movements; it must be divided into fractions, each directed by a subordinate commander; these fractions again must possess equal facilities of movement, and for this purpose be subdivided into smaller fractions led by a lower grade of officers; and, to crown all, each individual man in the smallest fraction must have been accustomed to stand, to turn, to advance, to retire at the word of command. Thus it appears that finally the efficiency of an army is reduced to the efficiency of the individual soldiers composing it. The art of tactics consists in so employing masses of individuals who have been thus trained implicity to obey a word of command, and to use the weapons entrusted to them, as best to carry out the great leading principle that large bodies of your troops should be opposed to smaller bodies of the enemy. This is the aim and object of the organisation of modern armies. Modern armies consist of cavalry, infantry, and artillery. First then I shall proceed to consider the leading methods of employing infantry.

Infantry formations are four in number, viz. Skirmishers—the Column—the Line—the Square.

1. *Skirmishers.* The general adoption of this formation of infantry in the armies of modern Europe dates from the French Revolution. The armies of the Republic consisted of hastily assembled levies unaccustomed to war, who had to confront the disciplined armies and systematic tactics of other nations. It was necessary to devise some novel mode of warfare in which to employ the newly raised armies, and such was found in the formation of skirmishers. When a position is to be attacked, a line of skirmishers precedes the main body, and by picking off individuals in the enemy's masses harasses his troops, shakes his line, and weakens the resistance he would have offered to the attack. In retreating in presence of an enemy several lines of skirmishers protect the rear; the rear line fires a few rounds, the skirmishers covering themselves as much as possible by irregularities of the ground, bushes &c. &c., and then retires at the double through the intervals of the others. In march-

ing through a woody or broken country, as was often the case in the Kaffir wars, skirmishers are thrown out in front, in rear, and on the flanks, to give timely notice of the approach of an enemy or an obstacle which might be in the road, such as a stream or ravine, and in an engagement such ground is always occupied by light troops employed as skirmishers. The skirmisher requires presence of mind and self-reliance; he acts to a certain extent independently, and should have a quick eye to seize any irregularity in the ground which may afford him cover, such as a bush, a heap of stones, a mound, a hole, &c.

When attacked by cavalry, skirmishers should run together and form small squares, of 4, 8, or 16 men, by standing back to back.

2. *The Column.* The Column is the formation best suited for the march, on account of its compactness. In action the leading divisions of a column are supported by those in rear, and they again are covered by it. The column has, however, been proved by numerous examples to be unsuited for attack ; none but the leading companies can deliver their fire, and, if attacking a line, the column will be exposed to its full fire; at close combat the leading division would be overpowered, and the remainder taken in flank, by the extremities of the line (fig. 2, pl. 1). An attack in column was skilfully repulsed at the Battle of Vimiera by a regiment in line,—the 50th. The regiment, 700 strong, was attacked by a French column of 2,000 men: the colonel changed his front, throwing back the left, against which the attack was directed, and bringing forward the right; then, delivering a volley at pistol shot, he charged, and the column was completely routed in the attempt to deploy (fig. 3, plate 1). If, however, infantry is exposed to attack from cavalry, it must be formed in quarter-distance column, as a square is soonest formed from this order; or, if the charge is sudden, it may even be sustained by a quarter-distance column, as was done by the Austrians at the battle of Aspern.

3. *The Line.* This is in almost all cases the best formation in collision with the enemy, but it should be formed before coming in actual contact with him, as a deployment under fire is a difficult and hazardous movement; each division, as it is in succession uncovered, becomes exposed to the fire of the enemy, and a charge

when the movement is being executed will probably be fatal (see plate 2, fig. 1). The great advantage of the line is that every man in it can use his weapon; but it is much more difficult to move than a column, both because it is less compact, and because the commander has to make his voice heard at a greater distance. When once broken through, a line is divided into two portions, which can be taken in flank and beaten in detail (pl. 2, fig. 2). A line deployed in echelon appears to combine to a great extent the advantages both of the line and column. One flank of an echelon is sufficiently retired to be secured from attack, and, though it may appear that the divisions composing it can be overpowered successively as they come up, yet this is not the case, as may be seen from plate 2, fig. 3, where A is a contiguous line attacked by B, a line deployed in direct echelon. B's left flank is sufficiently retired to be secure, and, if A attempts to bring some of his divisions from his right flank to overpower B's divisions successively, their own flank will be exposed to the fire of B's rear division. If B's left is supported by some natural obstacle, it cannot be attacked at all, and the leading division may be supported at the expense of the retired flank (pl. 2, fig. 3). From what has been said it is evident that the column is the formation best suited to the march; the line to collision with the enemy; and that a line deployed in echelon combines to a great extent the advantages of both. A good instance of the latter point was afforded at the battle of Meanee, where Sir Charles Napier attacked in direct echelon.

4. *The Square*, as is well known, is employed to resist the attacks of cavalry, and in the British service is formed four files deep. This formation has even been adopted on the march, as in the French campaign in Egypt on the march to Cairo; and during an engagement for purposes of attack, as was done by Marshal Macdonald at the battle of Wagram.

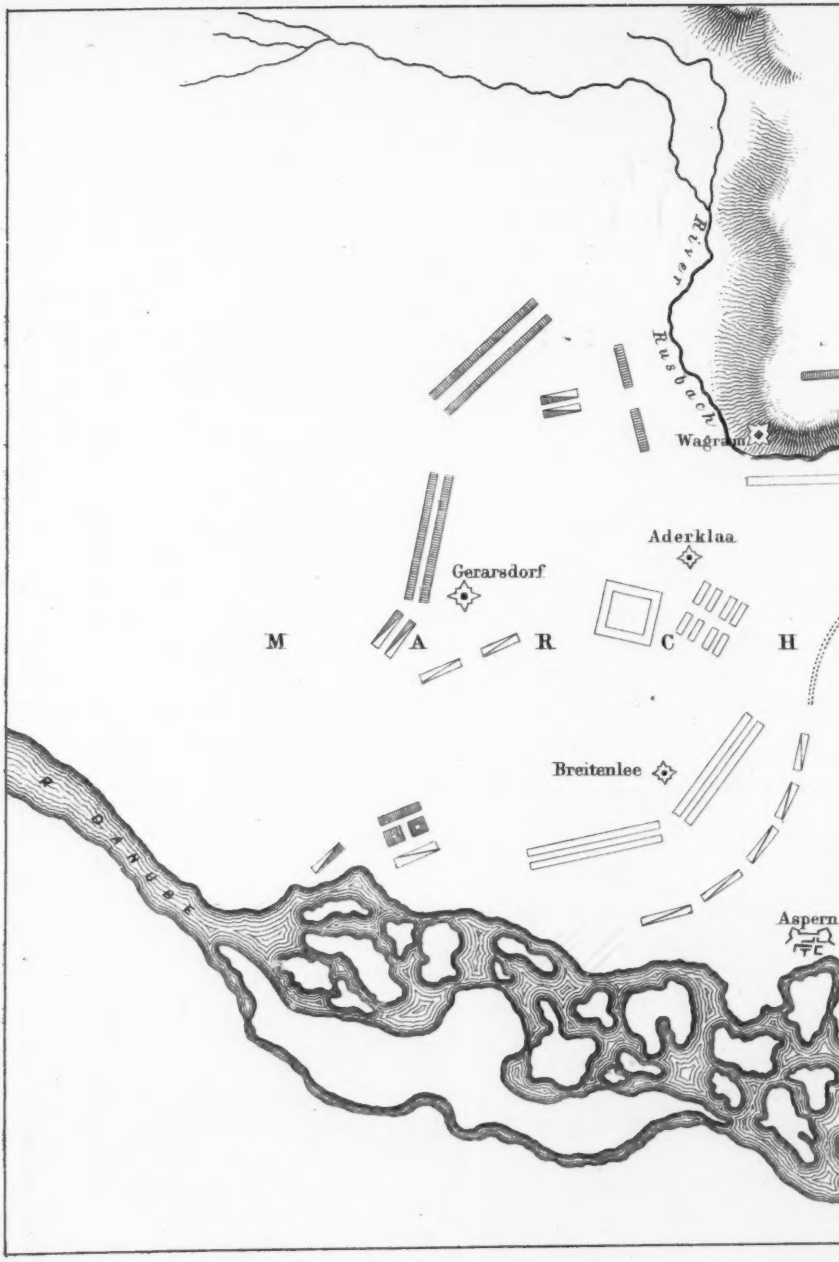
### Tactics of Cavalry.

Having briefly considered the chief features in the Tactics of Infantry, I now pass on to those of Cavalry. In all services cavalry is divided into Light and Heavy. Heavy cavalry in the British service is composed of large men, mounted on powerful

horses, and sometimes protected by cuirasses. Their principal use is to break masses of the enemy's troops. The utility of the cuirass has been questioned by some who are undoubted authorities on the subject; they have urged that defensive armour adds greatly to the weight carried by the horse, and unfits cavalry for any other duty than the charge in an engagement, and that the protection it affords the wearer is counterbalanced by its impeding the free use of his limbs and preventing him from injuring his opponent. On the other hand it may be said that heavy cavalry has done good service in every war. Napoleon's far-famed Cuirassiers often turned the scale of victory at a critical moment. At the battle of Borodino, the Russian redoubt, which was the key of their position, after a bloody contest which lasted many hours, was won by the Cuirassiers, who galloped in at the gorge. At Eckmuhl the Austrian Cuirassiers forming the rear-guard of the retreating army were engaged for some time in hand-to-hand combat with the Cuirassiers of the Guard, and the final defeat of the former was attributed partly to the fact that the Austrian cuirasses only protected the breast while those of the French covered the back as well. It is not perhaps generally known that the Life-Guards at Waterloo *without their cuirasses* defeated the French Cuirassiers armed as usual. Light cavalry performs very onerous and important duties. Together with light infantry it furnishes the rear and advanced guards of an army, and when in sufficient number the outposts and videttes; it frequently forages for the army, reconnoitres a tract of country that is to be occupied, disturbs an enemy's communications, intercepts convoys, and follows up a victory; in addition to all this, it is frequently called upon to perform all the duties of heavy cavalry. Some of the best writers seem to be agreed on the following points in the formation of cavalry.

1st. That in a charge the line should be formed in single rank; for if it charges in double rank the fire of the infantry will bring down a certain number of the front rank, and their rear rank men will fall over them.

2nd. That a line of cavalry should have intervals of at least twelve yards between the squadrons to allow for the opening out of the files at a gallop and to prevent crushing.


Rusbach
Wagram
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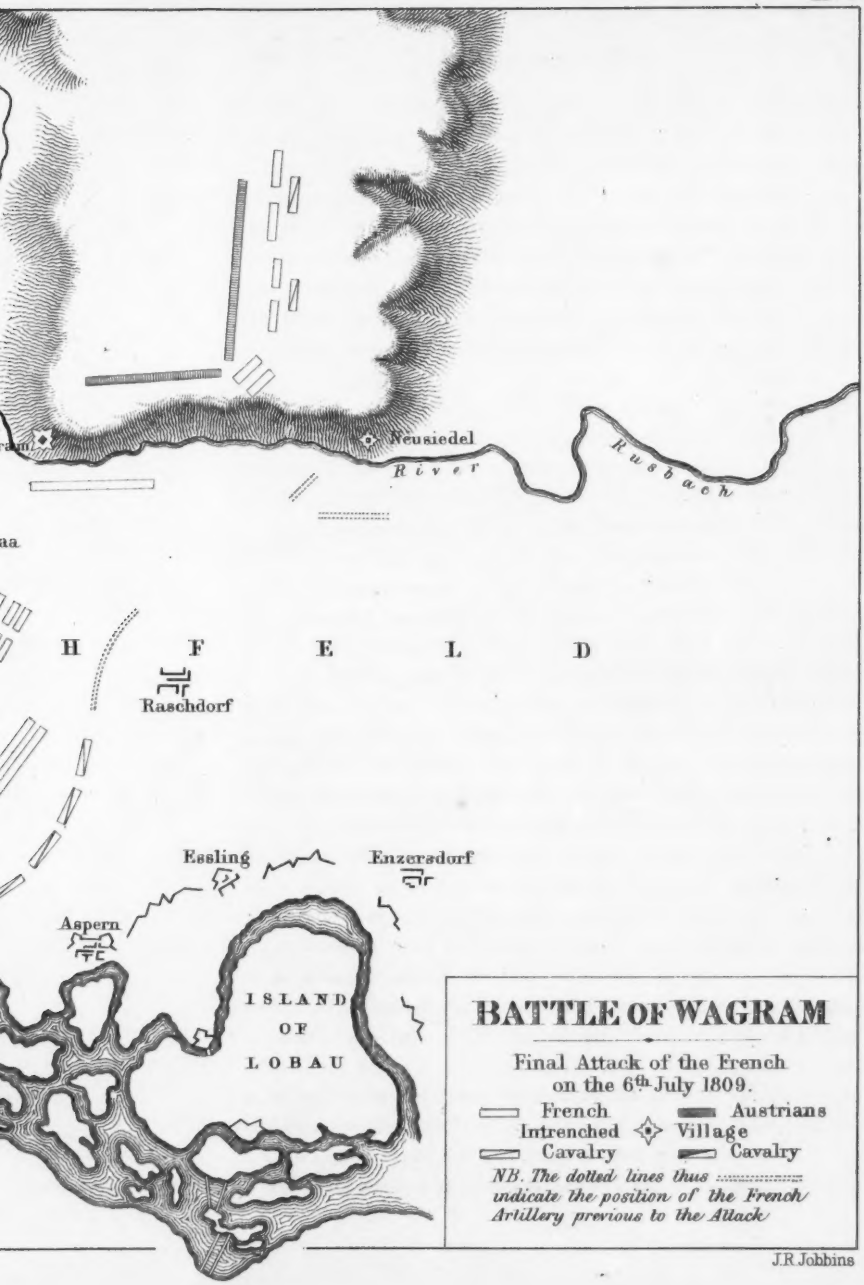



# BATTLE OF WAGRAM

Final Attack of the French on the 6th July 1809.

French Intrenched — Austrians Village

Cavalry — Cavalry

*NB. The dotted lines thus ..... indicate the position of the French Artillery previous to the Attack*

J.R Jobbins

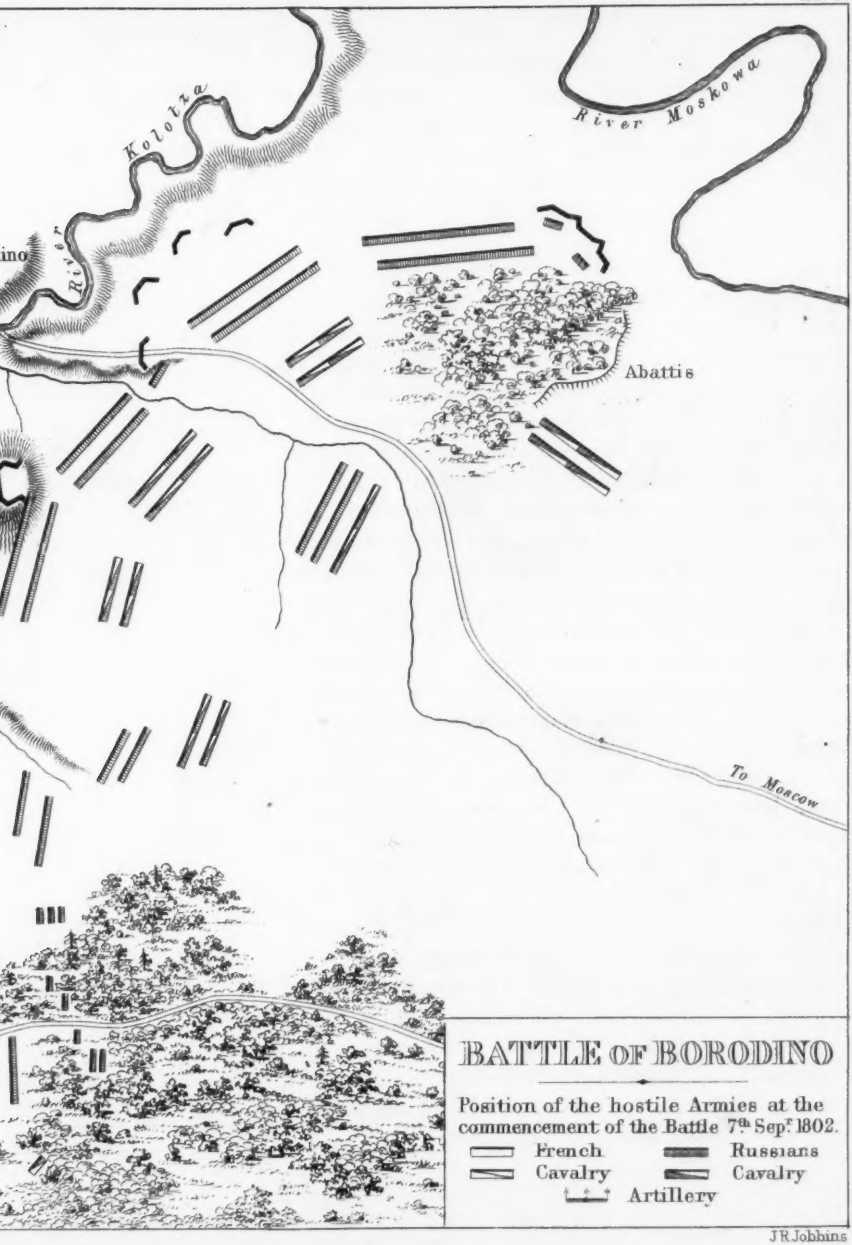
3rd. That it is of the very highest importance to keep a reserve in hand ready to hurl on the enemy at a favourable moment, and follow up the success achieved by a charge. In a cavalry engagement, victory has almost invariably fallen to that side which could produce the last reserve. The late Captain Nolan was of opinion that cavalry movements would be greatly simplified by the abolition of rear and flank, and right or left in front; whether the same holds good of infantry manœuvres is for experienced infantry officers to consider.

### Artillery.

No definite rules can be given as to the position which should be occupied by Artillery in a battle; the nature of the ground occupied by the army is the chief point which influences its selection. Points should if possible be selected from which a flanking fire may be directed on the advancing columns of the enemy, such as the salient and re-entering angles of a position. As a general rule artillery does not fire on artillery, except to draw off its fire when directed on the other arms; its object is to shake and thin the masses of an enemy before coming in contact with him. To accomplish this, its fire should be as *concentrated* as possible. The battle of Wagram afforded probably the most striking instance on record of what may be accomplished by the concentrated fire of artillery. (See diagram of battle of Wagram.) Napoleon had fixed the night of the 4th of July, 1809, for crossing the Danube, the island of Lobau being selected for the point of passage The Archduke Charles had taken up a position to oppose his passage in rear of an intrenchment connecting the villages of Aspern, Essling, and Enzersdorf. On the evening of the 4th July, Napoleon placed his army in the island of Lobau and directed the fire of his batteries on the village of Enzersdorf, silencing the Austrian artillery which was posted there, and setting fire to the village. By the light of the burning village the French Pontonniers threw a bridge across the creek of the Danube separating the island of Lobau from the mainland, and at sunrise on the 5th a great portion had crossed the river and formed on the other side. The Archduke Charles now fell back and took up a fresh position in the plain of the Marchfeldt, between the Danube

and the Russbach, his left resting on the hill overlooking the village of Neusiedel, which, as well as the hill, was defended by a numerous artillery, his centre supported by the intrenched villages of Breitenlee, Aderklaa, and Wagram, and his right leaning on the Danube. The battle commenced on the 5th. Napoleon attacked the village of Neusiedel with the view of turning the Austrian left, and cutting off the reinforcements that were coming up under the Archduke John, at the same time that Macdonald attacked the Austrian centre at Wagram. Both attacks failed; the French had crossed the Russbach, but were driven back for want of artillery to oppose that of the Austrians, and Macdonald was compelled to retire in disorder. The following day the French gained a partial success in the direction of Neusiedel, but the Austrian centre stood firm, and a decided repulse had been suffered by the French left; a division had been driven back into the island of Lobau, and its guns, placed too far in advance of their supports, had been captured; the Austrians were hourly closing in, the chances of victory were in their favour, and it was now that the concentration of the French artillery, and a vigorous attack on the whole Austrian position, turned the day. Twenty batteries, forming a total of 100 guns, were concentrated at Raschdorf, and a range of fire more than a mile in length sent devastation into the enemy's ranks; the Austrian artillery in the village of Aderklaa was silenced, the intrenchments levelled, and every attack they attempted repulsed with loss. Meanwhile the Duke of Auerstadt, supported by 64 guns, attacked Neusiedel and the table-land above it, silenced the 50 pieces by which the village was defended, and posted 12 large guns to sweep the ground between it and Wagram. On the left the Austrians were driven back and the captured guns retaken. The huge French battery in the centre now formed itself into a salient angle, one side being towards Aderklaa, the other towards Beitenlee; an enormous square, formed of several divisions under Macdonald, advanced through the opening, broke the Austrian centre, and compelled them to retire in every direction. Besides the striking examples which this battle affords of the use of the concentrated fire of artillery, several other points in connection with the employment of this arm are worthy of notice: in the first place the repulse of the French on the 5th from Neusiedel serves to teach that an attack will


Borodino
From Smolensko
River Kolotza
Great Redan
Advance Redouts
Old Road from Smolensko
Illitza




# BATTLE OF BORODINO

Position of the hostile Armies at the commencement of the Battle 7th Sept.r 1802.

French Cavalry
Russians Cavalry
Artillery

J.R.Jobbins

not be successful unless supported by artillery; the capture of the guns on the French left may remind us that artillery should not be isolated from its supports; and finally, the importance of intrenched points defended by artillery was well illustrated by the resistance made by the villages of Neusiedel, Wagram, Aderklaa, and Breitenlee.

I now pass on to make a few remarks on the selection and occupation of positions.

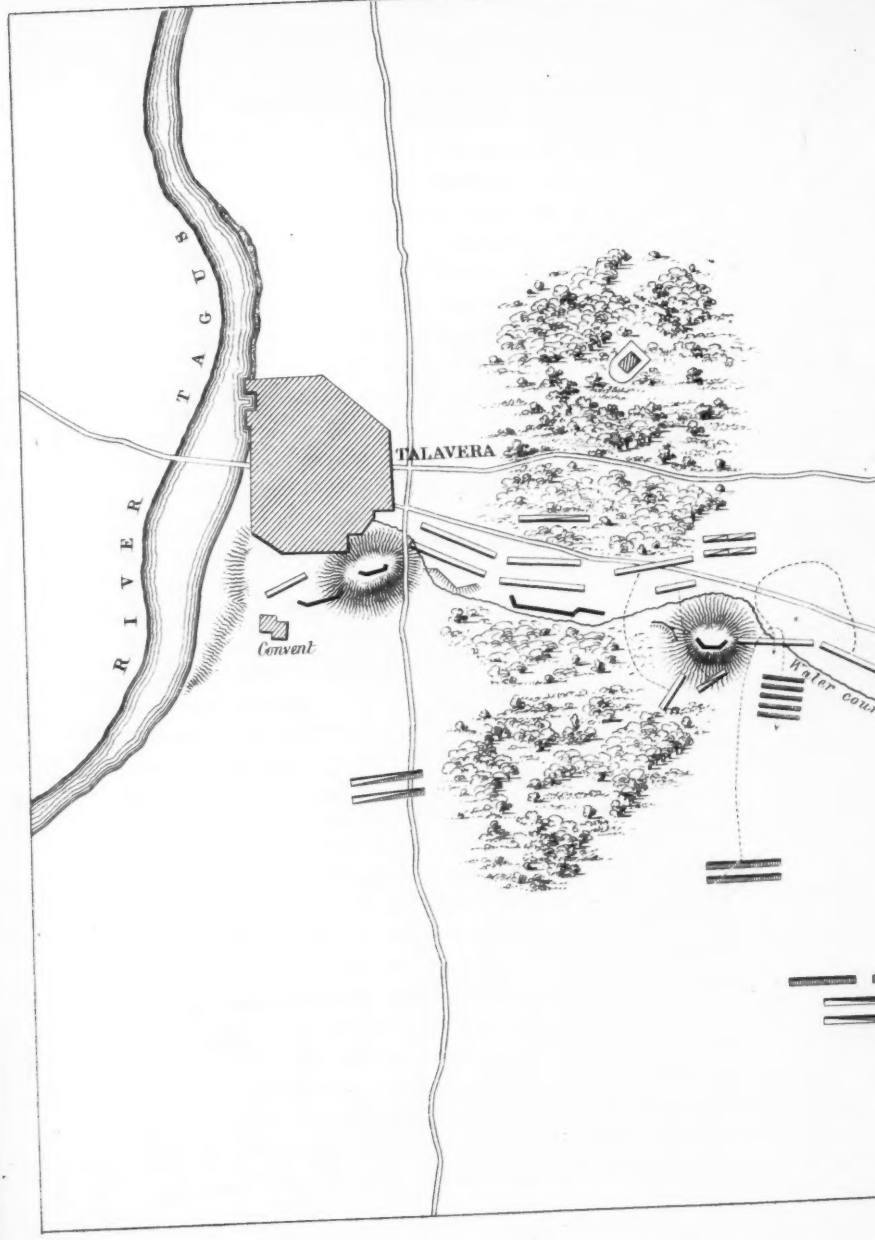
### Position.

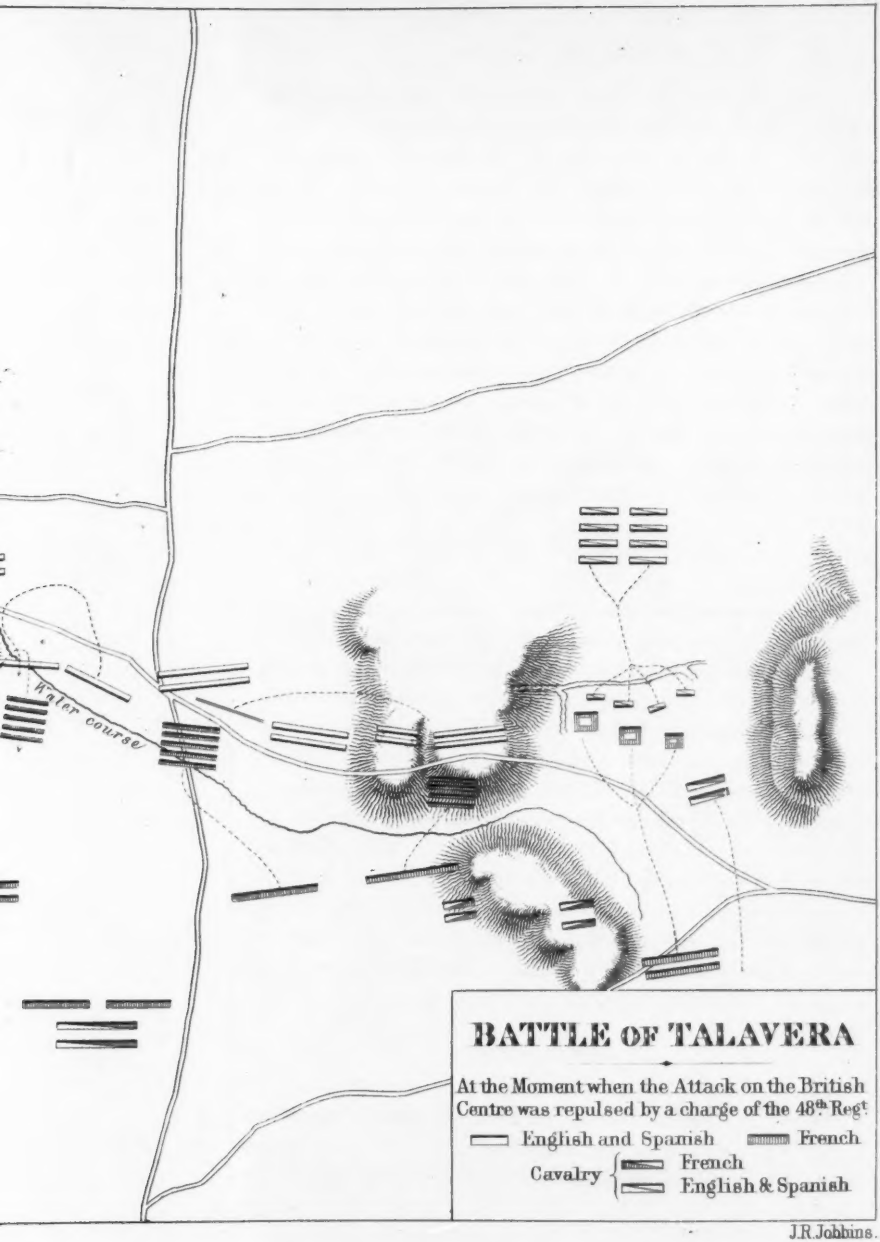
The choice of a Position depends upon the object in view; for a battle should never be fought without a fixed ultimate object. A defensive position may generally be selected by a retreating army in such a manner as to receive the utmost possible advantage, as the general knows that his opponent cannot advance without fighting a battle or he would risk his communications. Such a position is often at a point where several of the main roads converge, or at a point which covers the capital or some other important place. It should be of such a nature, if possible, that both the flanks may be supported by natural obstacles, and the front protected by a stream, marshy ground, &c. which will detain the enemy for a length of time under fire. Where such obstacles do not exist, the position should be strengthened artificially by abattis, redoubts, &c.: unimpeded communications should exist between the different parts of it; and in this respect an order of battle convex towards the enemy is advantageous, because the defenders can reinforce any point by moving on the chord of the arc, while the enemy will have to move on the circumference: finally, the lines of retreat should be as numerous as possible. The Battle of Borodino may serve to illustrate some of the foregoing principles. The Russians had hitherto uniformly followed the system of retiring before the invader, obstinately defending the various decisive points on the line of retreat. They were now, however, approaching their ancient and much-revered capital, and it was felt that to abandon Moscow without a blow would be to exchange the dogged determination with which the Russian troops had hitherto fought for despondency and discontent. Prince Bagrathion, who was selected for the command of the Russian army, in this extremity selected a position for defence on the Moskowa, near the village of Borodino. (See diagram).

His right was supported by woods, earthworks, abattis, &c. on a loop of the stream; as far as the village of Borodino his front was covered by the stream of the Kolotra, whose banks in this part are steep and rugged. Borodino was strengthened and occupied, and from thence to the left the position was artificially strengthened by a large redoubt, open at the gorge and situated on rising ground, defended also by heavy artillery. Three small redans were also thrown up on the left; the woods between them and the great redoubt, and the village of Ulitza, were occupied, and the village itself formed the extreme left of the position. It may also be observed that the Russians had two good roads to retreat by. This position was too strong to be attacked on the right, besides which that position was retired; and on the left the woods would have broken the formation of the attacking masses: the position therefore between the village of Borodino and the small redans was the only one that could be attacked, and thus the great redoubt was the key of the Russian position.

On the 6th September 1812 Napoleon attacked and took a small advanced redoubt near the village of Doronimo, not however without considerable loss; and on the 7th the grand attack on the great redoubt and the redans on the left of it was made, a diversion being also made on the Russian left. For hours the battle raged with unexampled fury round the great redoubt and the redans, which were repeatedly taken and re-taken, the Russians fighting on their own soil, for the safety of their own capital, and with courage wrought up by every possible expedient to a state of frenzy; the French, because life and safety as well as ancient prestige demanded that they should conquer until they could impose terms. At length, after enormous losses on both sides, the redoubt was captured by the Cuirassiers of the Guard, who entered by the gorge: there was but little fighting after this; and the Russians retired in good order, without leaving a single carriage or straggler to mark their retreat.

If an army consists partly of irregular troops, such as militia, &c. which cannot be relied upon to face the enemy in the open field, they should be posted in such parts of a position as are naturally or artificially strong, such as woody or broken ground, intrenched villages, &c. Thus the portion of the position selected by Sir Arthur


RIVER TAGUS
TALAVERA
Convent
Water cour




## BATTLE OF TALAVERA

At the Moment when the Attack on the British Centre was repulsed by a charge of the 48th Regt

English and Spanish
French
Cavalry { French / English & Spanish

J.R.Jobbins.

Wellesley at the Battle of Talavera, assigned to the Spaniards (see diagram), was rendered so strong as to be almost impregnable by woods, redoubts, abattis, a convent, &c. The line was prolonged by the British, and a hill formed the left of the position, which was about two miles in length; thus the centre was the weakest part of the position. The battle of Talavera was fought because an engagement was inevitable; Sir Arthur had the King and Victor in his front, Soult advancing in his rear, a chain of hills, the passes in which were abandoned, on one flank, and the Tagus on the other; thus all that could be done was to select the best possible position. The most serious defect in the one selected, was that it had but one line of retreat, and that one extremely difficult to be traversed by artillery or carriages. The position too was deficient in one most important requisite, viz. that a position should command all the ground within range of its guns: the hills opposite the British left were as high as those occupied by the British, which caused serious loss from the French artillery. The hill occupied by the British left, enfilading as it did the whole of their position, was the key; and against it and the centre, covered only by a watercourse, the most decided attack of the French was directed. The attack on the right was repulsed and ten guns captured: on the left the British cavalry met with a reverse, but the French did not venture to follow up their success, as there was still cavalry in reserve. In the centre the Guards at first repulsed the French attack, but, pursuing them too hotly, they were in turn attacked and thrown into great confusion; the French pushed on, and the British centre was broken through. The moment was a critical one; but a vigorous charge of the 48th Regiment repulsed the French, who retired at all points to the position they had occupied before the battle. The British were too much exhausted to follow up the victory, and the following day, being joined by Craufurd's Brigade, commenced the passage of the Tagus.

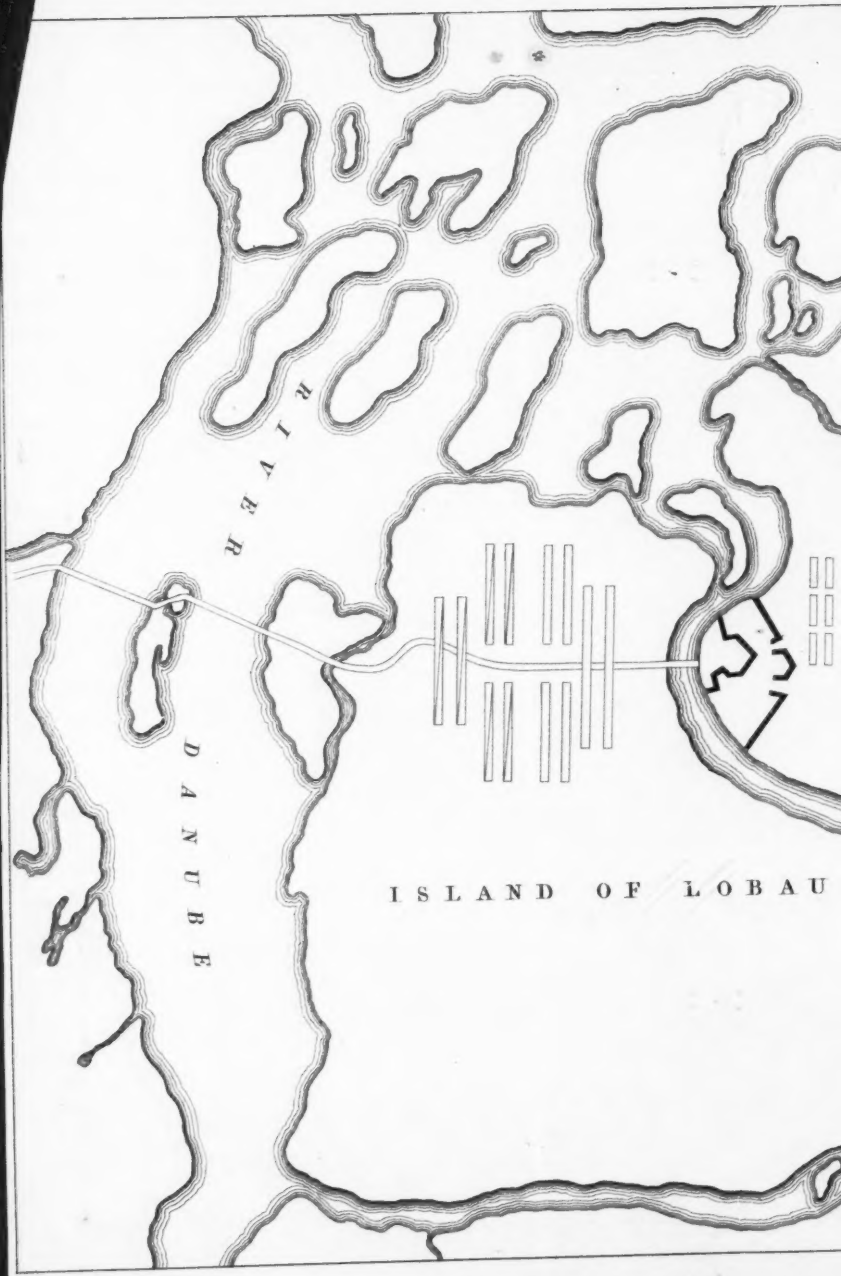
### Passage of Rivers.

Napoleon said that there were three species of obstacles which an army may have to overcome—a Desert, a Chain of Mountains, and a River; of these the most difficult to overcome is a Desert, the least a River. It may be laid down as a rule that an army provided

with a good pontoon train cannot be prevented from passing a river; and, even when attempted by vive force in presence of an enemy, the passage has often been accomplished. The ways of crossing a river are three, viz. by vive force, by stratagem, or by a combination of the two; of the first, Wellington's well-known passage of the Douro is a brilliant example. Time will only allow to give an instance of the last—the combination of stratagem and vive force.

In the spring of 1809 Napoleon designed to cross the Danube and attack the Archduke Charles, who was still in the field with 100,000 men, although Vienna had been taken: the island of Lobau was again selected as the point of passage. On the evening of the 20th of May, some light troops were pushed across the river in boats, and landed in the island, which was occupied by the Austrian advanced posts; the latter were completely taken by surprise, and had retired to the mainland before the Archduke was informed of the movement of the French. Some of his advisers urged him to oppose the passage; he however adopted a different course, and, ordering the advanced posts to fall back after a slight resistance, he retired with the whole of his army to a distance of eight or nine miles. He saw that Napoleon was making what might well be considered a false movement, and determined to allow a portion of his forces to cross, and then attack them when cut off from the remainder by the river, thus applying our leading principle at his expense. Meanwhile the French constructed several bridges between the right bank and the island, and the passage was commenced. But a single bridge of slighter construction than the others connected the island with the left bank: yet by 12 o'clock on the 21st 40,000 men of all arms had passed over: the villages of Aspern and Essling (see diagram) were occupied, and the space between them held by the Cuirassiers of the Guard under Bessières. Between twelve and one o'clock a column of 30,000 Austrians was seen advancing towards Aspern, and in a short time four others were descried directing their march on the French position.

The battle commenced with an attack on the villages of Aspern and Essling, occupied respectively by Massena and Davoust. Both were defended with desperate tenacity, but the superior numbers of the Austrians made it evident that they must eventually gain ground.


RIVER
DANUBE
ISLAND OF LOBAU


# BATTLE OF ASPERN

Second Attack of the Austrians on the Village of Aspern. May 21st 1809.

French  Austrians

Cavalry { French / Austrians

J.R.Jobbins.

The passage of the remaining troops was, therefore, hurried on, and the Cuirassiers were ordered to charge the Austrian centre. They succeeded in penetrating the first line, but were met by the Hungarian Grenadiers, who threw themselves into squares, and, supported by the cavalry of the centre Austrian column, compelled the Cuirassiers to retire. Meanwhile Aspern was carried and retaken, but again captured: and on the evening of the 21st it remained in the hands of the Austrians, who had closed on the French centre and surrounded Essling. By the morning of the 22nd, the whole of the French had crossed, but the battle was renewed with little better success; Aspern was retaken, but Essling lost; the bridges were destroyed by fire-boats, and some of them with great difficulty reconstructed: a last effort was made on the Austrian centre by the cavalry and Lannes' corps, but without success; finally the French retired with difficulty into the island. The great lesson to be learnt from this battle is, that one of the very worst positions in which a general can place himself is in a confined space with a rapid river running in his rear, and but a single frail bridge to secure his retreat. Why then did so great a master of the art of war place himself in so hazardous a position? The answer must probably be derived from political considerations. "You must accomplish something," said Napoleon, "every three months in order to captivate the French people." The presence of a large Austrian army in the immediate neighbourhood of Vienna cast, as it were, a reflection on his military genius, and it was doubtless his object to beat and disorganise it at all risks.

# Evening Meetings.

Monday, June 29th, 1857.

Colonel the Hon. JAMES LINDSAY in the Chair.

The Chairman announced that 25 New Members had joined the Institution since the last Meeting, viz.:—

LIFE MEMBER.

Robinson, R. Spencer, Capt. R.N.

NEW MEMBERS.

Andrews, W. G., Major Royal Artillery.
Maxwell, James, Brevet Maj. 34th Regt.
Henry, G. C., Major Royal Horse Atr.
Blackett, C. E. Capt. Cold. Gds.
Baillie, A. F., Ensign Bengal Eng.
Macnamara, F., Lieut.-Col. Clare Mil.
Gardner, W. B., Lieut.-Col. Royal Art.
Malcolm, G. A., Col. unattached.
Dunbar, W. M. Lieut. 34th Regt.
Williams, C. P., Lieut. h.p. Land Trs. Corps.
Haggard, W., Capt. East Norfolk Mil.
Leigh, Lord, Lord Lieut. co. Warwick.
Strange, H. F., C.B., Lieut.-Col. Royal Horse Artillery.
Strangways, W. A. F., Lieut.-Col. Royal Horse Artillery.
Armstrong, J. W., C.B., Dep. Batt. Colchester.
Swann, J. S. Capt., 54th Regt.
O'Halloran, H. D., Lieut.-Col. Dep. Batt., Limerick
Lumsden, H. W., Lieut. Madras Art.
Inglis, T., Capt. Royal Engineers.
Burrows, A. G., Lieut.-Col. Royal Art.
Baddeley, J. F., Major Royal Artillery.
Oldfield, Richard, Capt. Royal Artillery.
Daniell, C. F. T., Brev. Maj., 38th Regt.
Stevens, Wm., Capt. h.p. Land Trs. Corps.

INCREASED SUBSCRIPTIONS.

The undermentioned Officer had increased his Subscription from Ten Shillings to One Sovereign since the last Meeting:—

Cartwright, Henry, Colonel Gren. Guards.

DONATIONS.

List of Donations from 16th to 29th June.

*To the Library.*

Summer Tours in Central Europe, 1855-56. Part 3. Presented by John Barrow, Esq. F.R.S.

Atlas de l'Itineraire descriptif de l'Espagne, par Alexandre de Laborde.

Chart of Holland. Utrecht.

The Royal Navy Men's Advocate, 1757.

Army List, 1764.

Map of the Course of the Scheldt, with the Frontiers of Flanders and Brabant.

List of His Majesty's Royal Navy (Manuscript).

Plans of Dunkirk from the year 646 to the 31st December, 1768 (Manuscript). Presented by W. F. Higgins, Esq.

Ricordo Pittorico Militare della Spedizione Sarda in Oriente. Presented by General Della Marmora.

Observations made at the Magnetical and Meteorological Observatory at Toronto, Canada, Vol. III. for 1846, 1847, 1848. 4to. London. Presented by H. M. Government.

The only approved Guide through all Stages of a Quarrel. 12mo. Presented by Major-Gen. Falls.

*Miscellaneous.*

1. Fruit of the Coco de Mer of the Seychelles Islands, Indian Ocean.

2. Salmon caught with rod and line in the river Ness in Feb. 1857 by General Sutherland. Presented by General Sutherland, C.B.

Portrait of the late Duke of Wellington, with Autograph. Presented by John Barrow, Esq. F.R.S.

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## ON THE REGIMENTAL SCHOOLS OF THE FRENCH ARMY.

By Montague Gore, Esq.

The regimental schools of the French army are divided into two classes—one class for the privates, the other for the non-commissioned officers. I will first give a short account of the former.

Monsieur Roland, the inventor of the system pursued in these schools, and at present their general superintendent, was the master of a small village school, near the country residence of the late Marshal Soult, then Minister of War; who, having become acquainted with Monsieur Roland's method of instruction, was so much pleased with it, that he appointed a commission to inquire into its merits. It was arranged that fifty lessons of two hours

each should be given to four hundred pupils according to Monsieur Roland's method, and the same number of lessons to four hundred others according to that which was then followed in the French army. The report of this commission, which was made in 1840, was so favourable to Monsieur Roland's method, that it was adopted, and has since been pursued in every regiment.

Every regimental school is under the direction of an officer of the rank of lieutenant or sous-lieutenant, who has under him a monitor-general of the rank of serjeant, and three monitors. The director, monitor-general, and monitors, are exempted from all regimental duty. The director receives no allowance for his attendance at the school; the pay of the monitor-general and three monitors for a quarter amounts on the average to £1 16*s.** of English money. For every school of 200 pupils there are required 200 tablettes, 200 syllabaires (or school-books), 200 copies of the Gospel of St. John, a collection of copy-books, 3 large slates, 300 slate-pencils, 288 pencil-cases, and a few other articles; the cost of all which for a school of the size mentioned in Paris is about £27 English money. The other, or, if I may so call them, the *working* expenses of a school of 200 pupils once thus established, amount to £2 a quarter, or a little more; if to this be added £1 16*s.* for the pay of the monitors, the total expense of a school, after that incurred for its first establishment, does not amount to more than about £4 per quarter.

Each school, when two or three battalions of infantry are quartered together, consists of 200 pupils; where there is only one battalion, of 100; and the same with respect to cavalry. The attendance is compulsory on all soldiers who are unacquainted with reading, writing, or arithmetic. When this number exceeds 200, the major of the regiment selects those who are first to be sent to the school. No tables or seats are required, each pupil being provided with a tablette, which is suspended in front of the breast by a cord passing over the shoulders; a slate is inserted in it, and it answers the purpose of a table for writing; and also, being

* This sum may appear very small, but it must be remembered that the monitors continue to receive their regimental pay. I state the amount on the authority of Monsieur Roland, the superintendent of the schools.

hollow, of a locker to keep pens, school-books, and paper. The men are required to stand up during their lessons, which last for two hours each.

The officer who is the director must himself be fully acquainted with the system; he instructs the monitors, who afterwards teach the school.

It would be impossible within the limits of this lecture fully to detail the mode of instruction pursued; but the following brief account may give some idea of it:—

All the pupils being drawn up in line, a monitor proceeds to instruct them by means of a large slate suspended in front of him, on which all the letters of the alphabet are written. He points with a stick to each letter in rotation, pronouncing it, as he does so, with a loud voice, the pupils repeating after him; the monitor marking with his stick the regular time of the "pas ordinaire," in order that the pupils may pronounce with one uniform cadence. After having done this several times, he calls on some one pupil, to whom he gives his stick (or "baguette"), desiring him to point with it to each letter, pronouncing it aloud as he does so. The monitor then names particular letters of the alphabet, and requires the pupil to point to those he names. The pupil then returns to his place in the ranks, and others are called out, who are successively exercised in the same way.

Instructions are next given in spelling, pronouncing syllables, and reading.

The book in which they are generally first taught to read is the Gospel of St. John. The monitor announces that he is about to read some particular chapter, and that the pupils will be expected to follow him, and to pronounce the words after him. He then proceeds to read, observing, as in reading the alphabet, the regular cadence of the "pas ordinaire," in order that all the class may repeat simultaneously after him. It is material to observe that after reading the alphabet, spelling, or reading any book together, the pupils are called on to do so individually, in order the better to test their proficiency. Every pupil, besides being provided with a "tablette," has a "syllabaire," a copy of the Gospel of St. John, pencils, slate-pencils, pens, ink, and paper, which he is allowed to

take into his room, in order that he may follow up there the instructions which he has received.

In learning to write, the pupils begin by copying on the slates of their "tablettes" the letters, syllables, and words contained in their syllabaires. Copy-books are then given them with transparent paper over the copies, which they trace, thus learning the true slope and formation of the letters, and acquiring steady hands. After being perfect in this practice, they are no longer allowed the aid of copies to imitate, but are made to learn by heart a passage from some book; for instance, from the syllabaire (or school-book), or the *Théorie Militaire*, and then to write it from memory, afterwards comparing what they have written with the passage in the book, and correcting any faults of orthography.

In giving instructions in grammar, the monitor teaches the school how to form the plural of substantives in the following manner. He writes on the slate, suspended as I have mentioned before him, a certain number of substantives, which the pupils first spell and read, after which he explains to them how to form the plurals. They are then ordered to write on the slates of their tablettes the words which they have just spelt and read in the singular, after which they write the same words in the plural also, according to the instructions that have been given them. They are then taught how to connect adjectives with substantives, and pass on to the verbs.

The monitor explains to them the terminations of the present infinitives of the different conjugations, and the different moods and tenses of verbs. He then states what is the meaning of the verb, its subject, and its object.

The syllabaires of which I have spoken contain the principles of grammar and the rules of arithmetic; and the pupils are expected to learn out of school-hours in their rooms the verbs of the four conjugations given in the syllabaire, as well as the auxiliary verbs avoir and être. When they have learnt these, the monitor writes on the slate in front of him the infinite of some verb not contained in the syllabaire, say *commander*. The pupils compare this verb with the infinitives of the different conjugations in the syllabaire, and, finding that it corresponds with that of *aimer*, or the first conjugation, they conjugate it accordingly. After a few lessons, they

no longer require to refer to their syllabaires, but conjugate without assistance any verbs of which the monitor gives them the infinitive.

The syllabaire contains the definition and use of the parts of speech. After the pupils have studied these, they are examined in the following manner:—The monitor writes a sentence, say, "Le soldat prend son fusil." The pupils are required to mention the nature, gender, and number of each word as the monitor points to it. Thus, when he points to "Le," the pupils say, "Le, article, masculin, singulier." The monitor asks, "What is an article?" and the pupils answer according to the definition which they have learnt in the syllabaires. He then points to the word "soldat," and the pupils say, "Soldat, substantif commun, masculin, singulier." He then asks, "What is a substantive?" and they reply again according to the definition given in the syllabaires. They are then examined in the same way as to the remaining words.

In teaching arithmetic, the monitor commences by writing three rows of figures as beneath:—

| No. 1. | No. 2. | No. 3. |
|---|---|---|
| 1 | 10 | 100 |
| 2 | 20 | 200 |
| 3 | 30 | 300 |
| 4 | 40 | 400 |
| 5 | 50 | 500 |
| 6 | 60 | 600 |
| 7 | 70 | 700 |
| 8 | 80 | 800 |
| 9 | 90 | 900 |
| 0 | | |

He then remarks that the zero has no value by itself, but is of importance when joined to figures; that 4, for example, which in the first column represents only 4 units, indicates 40 in the second, because one zero is attached to it; and 400 in the third column, because two zeros follow it. He then points out to them how by decimal progression numbers amount to a hundred, then to a thousand, and then to a million.

The pupils are next instructed in the rules of arithmetic, and in the meaning of weights and measures.

### Class of Corporals.

Those admitted into this class are required to have previously gone through the course of instruction above mentioned in the schools, unless they have acquired the same amount of information without doing so. The pupils of this class read aloud, and afterwards learn by heart, a small book called "La Théorie Militaire," in which are explained all the exercises, manœuvres, and duties of infantry. They also, as indeed do all officers and non-commissioned officers, go through a course of instruction in intonation; the object of which is to enable them to give the words of command simultaneously in a loud and distinct voice. On one occasion I saw the non-commissioned officers going through this course at the barrack of the Ecole Militaire. The colonel in command told me, that, when first this practice was proposed, it was treated with considerable ridicule; but that its utility is now admitted, and that it is pursued in all the French army. He mentioned, too, that the voices of many men previously weak became strengthened by the exercise.

As I have already stated, I do not presume within the limits of a lecture to give more than a faint and imperfect outline of the system pursued in these schools. I may mention that I have visited them on more than one occasion. Every facility is given to those who are desirous of observing the working of the system, and Monsieur Roland is always anxious and happy to give the fullest information. His method of teaching has been in use in all the regimental schools since 1840; and he states that experience proves that a soldier, previously quite uninstructed, can acquire in these schools, without in any way neglecting his regular military duty, the instruction necessary to enable him to pass the examination required for attaining the rank of a non-commissioned officer, in the course of ten or twelve months;* that is to say, that he can become perfect in that time in reading, writing, and the four rules of arithmetic.

* The attendance required from each pupil in the school is twice a week for two hours each time. The school is open, and the director and monitors are obliged to attend five days in the week, the soldiers attending on the days they are off duty; but no soldier is required to attend more than twice a week.

I will now say a few words on the schools of the second degree, or higher class—those intended for the non-commissioned officers. No private soldier can be promoted to the rank of non-commissioned officer without passing an examination to prove that he is acquainted with reading, writing, and arithmetic; and no non-commissioned officer can be promoted to the rank of officer without undergoing a further examination, except in special cases where promotion is conferred for acts of valour in presence of the enemy. The commanding officers of regiments make a return every year to generals of division, and these to the minister of war, of the names of those non-commissioned officers whom they think eligible by their good conduct and their attainments to be promoted to the rank of officer. By an order of Marshal St. Arnaud, when Minister of War in 1853, it was enacted that no non-commissioned officers should be promoted, unless they had gone through the following course of study for two years, and could pass examinations in the subjects mentioned:—

First year: French grammar, arithmetic, geometry, military administration. Second year: Geography, history, fortification, study of maps. They are required to attend two lessons a week, each lesson occupying two hours. The second lesson of each week is devoted to the repetition and examination in what has been taught in the first.

The official programme states that the course of arithmetic includes the knowledge of common and decimal fractions; that of geometry the knowledge of angles, triangles, polygons, mensuration of surfaces, and of solids; that of military administration a full acquaintance with everything connected with the pay, commissariat, clothing, and lodging of the soldier; with hospitals and prisons; with the interior administration of companies and squadrons. The object of the course of geography is to give them general ideas of the science, and it is observed in the programme that good maps are of more use than fatiguing, and perhaps disgusting, the pupils, by loading their memories with proper names. The course of history comprehends not only the history of France, but general modern and ancient history. The commission appointed by the French government to make a report on these studies say that they

consider this course one of the most useful, and especially recommend it. They are, however, of opinion, that a general acquaintance with ancient history is sufficient, but that a more detailed knowledge should be required of modern history, especially of the military operations during the consulate and empire. The course of fortification is preceded by a lesson in descriptive geometry, and its object is to make the pupils acquainted with field fortification, the attack and defence of military posts and fortresses, the nature of the works required to protect them, and the communications between the several works.

In concluding this brief account of the system of instruction pursued in the French Regimental Schools, I have only further to observe, that it is not my intention to make any comparison between it and that which is followed in those of our own army. France and England were long opposed to each other in hostile array; more recently they have fought side by side as rivals for glory in one and the same honourable cause. May their armies henceforth emulate each other in good conduct, intelligence, and discipline! The education of the English soldier has been greatly improved of late years; the regimental schools of our army are conducted on an excellent system, and are well attended; and the men have every encouragement to pursue their studies under the auspices of that illustrious prince who commands the army, and, amongst whose other titles to the gratitude of the country, none is more honourable than that which he has so justly earned of "The Soldier's Friend."

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After Mr. Gore had concluded the reading of the above paper, the following discussion took place :—

The Rev. G. R. Gleig, Chaplain-General to the Forces, said he had the advantage of going through all the French schools, from the primary schools in the regiments up to the very highest schools in which the officers were taught. With regard to the regimental schools, he thought they were about the most defective, and the most miserable pretences, that ever could be witnessed. He never in his life saw an attempt to educate by signs and signals which so completely failed. In the British army they had a system

of education ten-thousand-fold superior to that which existed in the French army.

Colonel De Horsey asked the Lecturer whether the professors at the French schools were paid by the government.

Mr. Gore said they were, but the pay was very small.

The Rev. Mr. Birch, an Independent minister, formerly an officer in the army, said that the system of education adverted to by Mr. Gore was introduced into Paris more or less in connection with himself. He was in the exercise of his ministry there in the years 1838 and 1839, and he received a letter from the country recommending to him a poor French village schoolmaster. He was desirous of getting recommended to Marshal Soult, in order to introduce to him his system, which he had devised in the midst of his rural labours. That introduction was obtained, and the poor man was allowed to make an experiment with his system. On further trial the old system was entirely put aside, and the poor village schoolmaster's system was adopted.

Captain Bailey said, he had had some little connection with the French troops from having been posted near them, or actually with them, before Sebastopol, for upwards of six or eight months. He had always been under the impression that they had a very high system of military education, but, upon inquiry into the state of things, he was quite surprised to find that their system of education was not equal in any respect to that which exists amongst the regiments in her Majesty's service. Not one-tenth of the men in a French regiment were able to write the commonest sentence in French; and not only was that the case, but it also extended in a great measure to the officers themselves. He believed it would be found that the education in the French army extended only to certain classes of officers, namely, those who had been at the schools of St. Cyr and the Polytecnique, and those officers were rendered available for staff purposes.

Mr. Gore thought that the public papers made a very great mistake a short time ago, when they commented upon the superiority of the foreign schools to the English, because foreign languages were taught in them. That might be the case in Germany, but it was not so in France. Only the other day he went over a school in

France, and he asked the colonel whether English was taught. He replied that no foreign language was taught but German. Last year there were 700 pupils at St. Cyr, and not one of them could speak a word of English.

The CHAIRMAN (Colonel Lindsay) said, that our own military schools were working to as good an end as schools could possibly work. Before the war there was no doubt whatever that the system was not so perfect as it was at the present moment. He was greatly in favour of teaching a soldier a useful trade, so that when he went back to his parish, after having served under the Limited Enlistment Act, he might not only be a better man, but a useful member of society—able to support himself. It was both a moral and a physical question, and also a question of good government, and they ought to be greatly obliged to Mr. Gore for raising it.

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Wednesday, July 15th, 1857.

Rear-Admiral Sir T. HERBERT, K.C.B. in the Chair.

The Chairman announced that 11 New Members had joined the Institution from 30th June to 15th July viz.—:

LIFE MEMBERS.

Bell, Chas. Wm., Lieut. 15th King's Hussars.
Farmer, W. R. G., Lieut. Gren. Gds.
Smith, Horace J., Cornet South Herts Yeomanry.

NEW MEMBERS.

Blackett, E. W., Captain Rifle Brig.
Nason, John, Major Dep. Bat. Athlone.
Boyle, C. E. W., retired Rear-Admiral.
Pennington, Hon. J. F., Capt. h.p. 90th Foot.
Inglis, Chas. D., Lieut. R.N.
Daubeney, A. G., Captain h.p. 90th Ft.
Hartley, Rd. W., Captain 94th Foot.
McDonald, A. M., Major Rifle Depôt Battalion.

INCREASED SUBSCRIPTIONS.

The undermentioned Officer had increased his Subscription from Ten Shillings to One Sovereign since the last Meeting:—

Pennington, Hon. Jno. Fras., Captain h. p 90th Foot.

## DONATIONS.

### List of Donations from 30th June to 15th July.

*To the Library.*

Two manuscript copies of Lectures, delivered by General Sarey at the Senior Department of the late Military College at Wycombe. Presented by Charles E. Long, Esq.

Three copies of the Report of the Dublin Sailors' Home. Presented by General Falls.

Archæologia, Vol. XXXVI. Parts 2 and 3, and 3rd Part of Vol. I.

Proceedings, &c. 43 to 46.

List of Fellows for 1856 and 1857.

Presented by the Society of Antiquaries.

The Royal Warrant of the 6th October, 1854, and its effects on the Lieut.-Colonels of the Army who had obtained that rank before the 20th June, 1854. Pam. 8vo. London, 1857. Presented by Col. the Hon. J. Lindsay, Gren. Gds.

Annals of the Wars, 1700—1739, 1 vol. 12mo. London, 1857. Presented by Major-Gen. Hon. Sir Edward Cust, K.C.B.

Alphabetical List of the Officers of the Gren. Gds. from 1800 to 1854.

Ditto ditto 79th Highlanders, 1800 to 1851.

Ditto ditto 4th R. I. Drags. 1800 to 1856.

Military Obituary for 1853—54—55—56.

Presented by Henry Stooks Smith, Esq.

Report on the Examination of Appointments to the Royal Artillery, and Admissions to the Royal Military Academy at Woolwich. Presented by Col. Lefroy.

Proceedings of the Royal Society, Vol. VIII. No 26. Presented by the Society.

The Isthmus of Suez Question, by M. Ferdinand de Lesseps.

Ma Mission à Rome, Mai 1849. Par M. F. de Lesseps.

Six Numbers of the Journal de l'Union des deux Mers, 20 to 26.

Reponse de M. F. de Lesseps, au Ministre et au Conseil d'Etat.

New Facts and Figures relative to the Isthmus of Suez Canal. Edited by M. de Lesseps.

Inquiry into the Opinions of the Working Classes of Great Britain on the Suez Ship Canal. By M. F. de Lesseps.

Isthmus of Suez Ship Canal Report, and Plan of the International and Scientific Commission, with Appendix.

The Gates of the East. By Charles Lamb Kennedy, Esq. Barrister-at-Law.

Atlas. M. F. De Lesseps sur Percement de l'Isthme de Suez. Presented by Major-Gen. Honble. Sir Edward Cust, K.C.B.

*Miscellaneous.*

Mass of Spar found near Frome, in Somersetshire, in the year 1840. Presented by Mr. S. Naylor.

A Carabine à tige. Presented by Lieut.-Col. T. St. Leger Alcock.

REAR-ADMIRAL SIR T. HERBERT, K.C.B., in the Chair.

## EUCLID RENDERED PRACTICALLY AVAILABLE TO THE EXIGENCIES OF MILITARY SERVICE, IN THE USES OF THE INSTRUMENT CALLED THE POLYMETER.

BY THE REV. F. R. A. GLOVER, M.A., CAMB., THE INVENTOR.

"EUCLID" being rather a dry subject, the object of the Lecturer in adopting the above heading for the Lecture was the endeavour to make that Great Master a favourite in quarters where his matter is looked upon rather as a dose of physic than as an agreeable condiment. This was done by showing the practical utility of his labours in their application to all those points of military resource realizable by the instrument, the POLYMETER, to which he drew the attention of the audience; his statement being, that, inasmuch as all Geometrical Instruments were based, in their action, on certain principles in physics, exhibited in some of the books of Euclid, and as this Instrument combined the uses and operations of many, this one might be considered a working model by which to exhibit practically, and to realise in a handicraft way, the results of all the books of that ancient author.

Having stated this intention, the Lecturer then proceeded to show the order of the growth of the Polymeter out of the common Sector, which it resembles in form, though it has no working resemblance to that instrument, all its lines of graduation being entirely different, the sectoral lines of the common sector being all obtainable in the Polymeter otherwise. Yet, as, besides doing all the trigonometrical work of the sector, together with that which is usually performed by the sextant, protractor, magnetic surveying-compass, spirit-level, Marquois' scales, proportional compasses, and calliper compasses, it adds to the powers of all these instruments those of a reflecting azimuth, a mid-day dial, and ready-reckoner, its title to its name is well established. For it is in this combination of many instruments in one, of which the common sector is the basis, that all the processes of mensuration can be achieved, without recourse to any other instrument or means other than

those which the Polymeter itself provides: the elements, for example, for heights and distances being obtained by the Polymeter, the practical result is realised on the spot, without recourse to square root or logarithms; the ground problems can be also worked on the ground or ramparts and breastworks thrown up, without the aid of stakes, pickets, or lines.

The accompanying Plates will give our readers a better idea of this OFFICER'S VADE MECUM than any lengthened report of the Lecture, or description of the instrument as given at the time, in illustration of its range: to do so would, indeed, be to reprint a book of some bulk, explaining its various uses and powers, published elsewhere.

The following detailed description of its appearance, and catalogue of its uses and contents, may not be unacceptable to our readers. It is a metallic folding foot-rule, 7 inches long, $2\frac{1}{4}$ inches wide, $\frac{3}{8}$ of an inch thick. It is so arranged that it shall be a standard of weight, viz., a test of a pound imperial, as well as a standard of lengths and liquids. The leathern case of the instrument constitutes the sketcher's tablets and memoranda book.

### STRUCTURE AND CONTENTS OF THE POLYMETER.

*No.* 1, *Protractor.*—A six-inch Sector with 1-inch radius joint, and graduated disc, showing the 360 degrees of the circle, with a Vernier's scale to read to 1 minute of a degree, constituting a Protractor.

*No.* 2, *Quintant.*—No. 1, with a hinged mirror in the middle of the disc of the joint, constituting a quintant, reading to 160°, that is, taking angles up to 160°.

*No.* 3,* *Double Sextant.*—No. 2, with a hinged mirror *en annexe*, constituting an instrument which takes an angle of 260°; being more than 120° (the sextant's range) multiplied by 2; and no "bad" angles.

*No.* 4, *Reflecting Quintant Compass.*—No. 2, with a magnetic needle in a revolving needle-box, with Sight Vane, reading from 15° to 160° E. and W. of meridian. The magnet is no longer needful for road, lane, and boundary surveying, it being superseded for such purposes by No. 3.

*No.* 5, *Artificial Horizon*, { 1, With a spirit-level. 2, A pendulum with horizontal balance. 3, Metallic mirror, variously used.

*No.* 6, *Gunner's Quadrant.*

*No.* 7, *Meridian Dial, Latitude Instrument, and Azimuth Circle.*—Nos. 4 and 5, with mirror, double-faced and lined on each face.

*No.* 8, *Telescope en annexe*, (extra.)

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* This has been added to the Polymeter since the delivery of the lecture.

*No.* 9, *Ball-and-socket Walking-stick Tripod*, (extra.)

*No.* 10, *Proportional Compasses.*—Three comparative graduations for circles, planes, and solids.

*No.* 11, *Calibre Compasses.*—Calliper scales on the reverse of the disc, for diameters of balls and their weight. Sliding rule from 1¼ to 18 inches for internal calibre.

*No.* 12, *Universal Scales and Triangle, Parallel Ruler.*—23 linear English graduations from 2 to 24 to the inch, including those of Marquois' scales. Three foreign. Foreign mile ladder.

*No.* 13, *Trigonometer.*—Line of lines with graduated square, being a Sining-Rod for sines, with a Vernier's scale. Graduated three-quarter circle, with Vernier of No. 1 for angles.

*No.* 14, *Slope-gauge*, a substitute for pickets and tapes in throwing up parapets, &c., the combination of No. 13 with 1 of No. 5.

*No.* 15, *Stadium for taking distances at sight.*

*No.* 16, *Standard of weight.*

*No.* 17, *Thermometer*, (extra.)

*No.* 18, *Case and Sketching-tablets.*

To be had at Elliott Brothers, Strand, London.

The annexed woodcut, for the use of which we have to acknowledge the courtesy of the proprietors of the Illustrated Inventor, shows the general appearance of the Polymeter, as it is arranged to take an observation either magnetic or as by Sextant. The Artificial Horizon and the Square are lying beside it. The *annexe*, which constitutes the Double Sextant, is not exhibited in the woodcut.

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ERRATA.

Page 42, line 4, *for* "lochi," *read* "syntagma."

„ last line, *for* "Macedonians," *read* "Spartans."

Planes
ME
3W
ME
3W

# The POLYMETER. The OBSERVING FACE.

PLATE 2.

## PLATE II.

### The Polymeter. The Observing Face.

*a b, c d.*—Inner edges of the Sector, showing a scale of 4 inches to a mile in yards. Each portion represents 50 yards, and each number stands for as many hundred yards from the centre of the joint of the instrument at *o*.

*e.*—The air-bubble of the spirit-level.

*f g h i.*—The foot English in tenths and hundredths ; the scale of 50 of Marquois.

*j.*—The folding-down reflecting mirror.

*k, l, m, n*—Scale of 35, 40, 45, 60 of Marquois' scales.

*o.*—The centre of the joint of the instrument.

*q p s.*—The square, graduated to the scale of 60 of Marquois, and marked with the numbers of the draw-rule in inches. The other numbers stand for half-inches. The circle at its end represents a small lens, with which to read off the circular Vernier scale.

*o* r, *o* u.—Radial lines, showing the proportions of the proportional compasses in planes, solids, and polygons. The numbers read in accordance with the words to which they belong.

u u, r r.—The same, prolonged over the ends of the Sector.

*o* t.—The middle joint of the instrument.

t t.—The opening of the point at the end of the legs of the Sector.

*v w*, y x.—The end of the instrument.

*z.*—A falling mirror—the mirror, *en annexe*, alluded to under head No. 3, *Double Sextant*, in page 281.

## PLATE III.

### The Polymeter. The Scale's Face.

a b.—The Stadium scale for man and horse, on one of the outer edges of the Polymeter.

c d.—Scales of 7, (14.21,) 9, (3·6, 12·15,) 11, 13, 17, and 19 to the inch.

c d, s v, when the Sector is opened out, constitute the foot measure, to the inches of which, the numbers 1 to 12 inclusive refer.

s r is a scale of 6 inches, the $\frac{1}{2}$ foot; the inches are divided in 8ths.

*e* is the air-bubble of the spirit-level.

e f.—The Calibre scale for the measure of balls, &c.

f g.—The Calibre scale of weights of balls.

h i.—$\frac{1}{6}$ of the French metre, shewing decimetres and millimetres.

j k.—Diagonal scale of hundredths to the half and quarter inch, each subdivided into hundredths.

l m.—A scale of 3 inches to a mile on the other outer edge of the Sector.

s p q.—The square graduated to 20ths of an inch; the numbers shew half-inches.

n.—Tell-tale lines.

o.—The Vernier, for the line of lines.

*o* t.—The middle line of the Sector; the two edges shew a graduation of 20 to the inch, and are the same as the line of lines of the Sector.

*o* r, *o* u.—Radial lines for using compasses.

*v* x y *w*.—The ends of the Sector.

w x.—$\frac{5}{13}$ of a French foot.

y z.—$\frac{5}{13}$ of a German foot.

# The POLYMETER, The SCALE'S FACE.

PLATE. 3.